

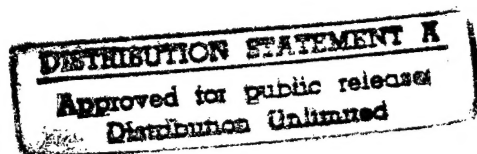
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# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING



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22 JANUARY 1987

USSR REPORT  
ELECTRONICS AND ELECTRICAL ENGINEERING

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UDC 621.391.019.4

NOISE FILTRATION IN DYNAMIC REGIMES WITH DISCRETE TIME

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 5, May 86  
(manuscript received 26 Nov 84) pp 911-914

[Article by A. S. Pikovskiy]

[Abstract] A method of noise filtration in dynamic systems is proposed. It is shown that, according to data obtained in a system with noise, this method makes it possible to construct a new system in which the effective noise is smaller. The method can also prove to be useful in determining the nature of irregular conduct under observation. Externally random conduct can be observed in two situations: 1) If a strange attractor exists in a totally deterministic system; and 2) If a stable, regular regime exists in a system, which is destroyed by fluctuations. A decrease of the effective noise in the filtration process makes it possible to distinguish these two situations. Figures 2; references 8: 1 Russian, 7 Western.

6415/12955

CSO: 1860/277

UDC 621.396.96.01'03

ASSESSMENT BY SPACE-TIME TREATMENT OF SIGNALS OF THE PARAMETERS OF A COMPLEX  
TARGET BEING RESOLVED

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 3, No 5, May 86  
(manuscript received 17 Dec 82) pp 1029-1032

[Article by A. P. Trifonov and A. N. Lukin]

[Abstract] In a previous article by Trifonov and Lukin, published in this same issue of RADIOTEKHNIKA I ELEKTRONIKA (May 86, pp 883-890), general expressions are obtained for the characteristics of an assessment of the parameters of a complex discrete target which consists of a  $p$  brilliant points (point resolution), or  $p$  point radiators with passive detection and ranging. The overall results of this previous article are defined more precisely and applied here to a special case, i.e., an assessment of the parameters of a target being resolved. Figures 1; references: 3 Russian.

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# SOLUTION OF UNIVARIATE PROBLEM OF SIGNAL RESTORATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 3 Apr 85) pp 829-831

[Article by V. N. Zhigulev]

[Abstract] A discussion is presented of the general statement of a univariate problem of restoration of a signal or image from a measured process. The problem is to construct an estimate of the measured process based on the realization of the process received by the present moment in time using a filter which can be physically constructed. The optimal solution of the univariate process of restoration of the signal is an analog of the Kalman filter with a dynamic operator  $K \langle \cdot \rangle$  in the direct information processing circuit if the smoothing operator of observation  $H \langle \cdot \rangle$  is a physically impossible operator, or with an ordinary variable gain  $K(t)$  if  $H \langle \cdot \rangle$  is physically realizable. Figures 2, references: 2 Russian.

6508/12955

CSO: 1860/261

## FREQUENCY RANGE OF ANALOG TO DIGITAL CONVERTERS

Novosibirsk AVTOMETRIYA in Russian No 1, Jan-Feb 86  
(manuscript received 27 Jun 84) pp 97-100

[Article by V. P. Doroshev and V. Ye. Yamnyy, Minsk]

[Abstract] Analog compression is employed for dynamic range expansion in A/D converters, though this as a rule entails an increase in the signal bandwidth and a dynamic error due to spectrum limiting in the converter circuits following the compressor. This approach narrows the input signal frequency range for broadband A/D converters. Design equations are derived in this paper for the attainable input signal frequency range, given a specified dynamic conversion error for the following popular compressors used in A/D converters: 1) Linear-logarithmic; 2) Biased logarithmic; 3) Fractional power law; 4) Quasilogarithmic; 5) First order convolution (rectifier), and 5) Third order convolution. The algorithm used to generate the numerical model of the A/D converters is described. The optimal scales for such converters, in the sense of a maximum input frequency band are the linear-log and biased-log compression scales, which are also optimal in terms of the dynamic input signal range. The derived equations can be used to readily determine digitizer bandwidth requirements. The use of a rectifier at the converter input substantially narrows the input signal band, even if the dynamic range is only doubled. The frequency range of A/D converters is less critical to the dynamic error than the dynamic range is to quantization error. Figures 2; tables 1; references: 2 Russian.

8225/12955  
CSO: 1860/242

UDC 621.372.542:376.56

# IMPLEMENTATION OF DISCRETE FOURIER TRANSFORMATION WITH DELTA MODULATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 5, May 86 (manuscript received, after revision, 30 Oct 85) pp 60-65

[Article by V. A. Pogribnoy and V. P. Yakovlev]

[Abstract] Delta modulation with uniform discretization is considered systematically for use in discrete Fourier transformation, in a mixture of formats which will reduce the number of additions and multibit multiplications further than does one format alone. Fast algorithms in a hybrid format are devised by reversing the sequence of additions. Multibit multiplications are eliminated by use of delta modulation, which replaces them with a larger number of simple logic operations on single-bit delta codes. A processor implementing such algorithms contains a direct-access memory for quantization steps, a read-only memory for sums of sines and cosines in pulse-code-modulation format, two modulo-2 adders with negation, an array of algebraic sine and cosine adders, and two direct-access memories for output of extracted real parts and imaginary parts, respectively in pulse-code-modulation format. Figures 1; references 4: 2 Russian, 2 Western.

2415/12955

CSO: 1860/296

UDC 621.396.96:621.391.26

QUASIOPTIMAL SPACE-TIME PROCESSING ALGORITHM FOR WIDEBAND SIGNALS

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 5 Jun 85, after revision) pp 40-43

[Article by A. M. German and Ye. A. Grishina]

[Abstract] A quasioptimal algorithm for space-time processing of wideband signals is proposed in which an entire group of azimuth channels is formed with one-time compensation of the group delay and quadratic phase incursion. The algorithm simplifies processing of wideband space-time signals in the Fresnel zone, reduces the computational resources required, and permits existing hardware and methods for far-zone signal processing to be used. Figures 4, references: 4 Russian.

6900/12955  
CSO: 1860/222

UDC 551.51.001.24

PROBABILISTIC MODELLING OF FIELDS OF OCEAN WAVE AND ATMOSPHERIC TURBULENCE  
IN STUDIES OF COMPLEX SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 12 Nov 84) pp 721-729

[Article by Yu. I. Palagin, S. V. Fedotov and A. S. Shalygin]

[Abstract] This article is dedicated to development of mathematical (simulation) models of atmospheric turbulence and ocean wind waves. The models are quite suitable for probabilistic investigation of nonlinear stochastic systems. An example of modelling is presented. The models suggested, based on parametric representation of random fields, have no systematic errors with respect to the spectral correlation characteristics and require limited computational resources. The models are distinguished from previously known models in that the ocean surface and turbulence of the atmosphere are modelled as implementations of random fields rather than processes. The example illustrates correct reproduction on a computer of the probabilistic properties of the fields, confirming the need to consider the 3-dimensional nature of the structure of the fields during studies of many complex information and control systems. Figures 5, references 17: 15 Russian, 2 Western.

6508/12955

CSO: 1860/261

UDC 621.396.392.3

DATA ABOUT TARGET IN RADAR CHANNEL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 5, May 86 (manuscript received 2 Apr 85) p 87

[Article by A. V. Burakov and A. D. Viktorov]

[Abstract] A radar channel containing Gaussian noise is considered in addition to target data is considered, and the dependence of its volume of target data on both the target selectivity and the Doppler effect is determined as the difference between channel capacity, respectively without and with target data, normalized to the channel capacity without target data. Figures 1; references: 1 Russian.

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CSO: 1860/296



UDC 621.3.072.86

WIDE-BAND FOUR-CHANNEL EQUIPMENT FOR DISTRIBUTION OF THE POWER OF HIGH-FREQUENCY OSCILLATIONS

Moscow ELEKTROSVYAZ in Russian No 6, Jun 86 (manuscript received 1 Oct 85)  
pp 41-44

[Article by L. A. Bessonova, S. Ye. London and S. V. Tomashevich]

[Abstract] In recent years there has been much interest in the problem of high-speed (electron) redistribution of the power of generators of high-frequency oscillations between loads, e.g., antennas. It is possible to solve the problem by a change of the relative phases of the oscillations of the generators connected in multiport hybrid devices used in phased antenna arrays. In the microwave frequency band, hybrid devices are realized by waveguides and pieces of long lines. Hybrid devices of transformer type are used to decrease the dimensions. Use in them of ordinary transformers with winding does not make it possible to obtain the requisite frequency band. For its enlargement, the windings are realized in the form of pieces of long lines. In this case the best results are attained with the production of a hybrid device in the form of a unified multiport device. A device of this class, designed for linking up generators and loads, nonsymmetrical and symmetrical relative to the common bus, is described. The theoretical and experimental results obtained indicates the possibility of using this device in phased antenna arrays in the high-frequency and very high-frequency bands at a level of power up to units of kilowatts. Figures 3; references 7: 6 Russian, 1 Western.

6415/12955

CSO: 1860/310

UDC 621.371.334

NUMERICAL ANALYSIS OF REFLECTING DIFFRACTION GRATINGS

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 17 Jun 85) pp 62-64

[Article by V. V. Korsunov]

[Abstract] A procedure is developed for numerical solution of the problem of diffraction of electromagnetic waves by a reflector-type grating coated with a thin dielectric layer uniformly covering the surface of the grooves. The algorithm makes it possible to investigate the effect of a thin dielectric film on the reflecting properties of gratings, and is suitable for practical use. Tables 1, figures 2, references: 6 Russian.

6900/12955  
CSO: 1860/222

PLANE WAVE DIFFRACTION ON LARGE-RADIUM DIELECTRIC CYLINDERS

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 11 Jun 85, after revision) pp 66-68

[Article by A. A. Vorontsov and S. D. Mirovitskaya]

[Abstract] Modified analytical formulas are proposed for the problem of plane wave diffraction on dielectric cylinders with small or large radii. The formulas, which are free of computational errors, are derived by using special functions to replace the Bessel and Hankel functions ordinarily employed. Recursive formulas are derived for computing the new special functions with the help of existing recursive formulas for cylindrical functions. The proposed modified formulas are shown to be effective for constructing the diffraction patterns of dielectric cylinders and for finding the angular position of the minima of these patterns as a function of the diameter. References 6: 3 Russian, 3 Western.

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UDC 621.396.96:551.508.85

USE OF LFM SIGNALS FOR ATMOSPHERIC SOUNDING

Moscow RADIOTEKHNICA in Russian No 2, Feb 86  
(manuscript received 20 May 85, after revision), pp 74-77

[Article by V. R. Zhezherin and L. V. Knyazev]

[Abstract] The use of continuous-wave linear frequency modulated signals in the UHF band for atmospheric sounding is investigated. CW LFM signals have a number of advantages over the coherent pulse radars that are widely used in meteorology: There is no dead zone, it is comparatively easy to obtain good spatial resolution, the equipment is simple and compact, and the operating modes are adjustable. The characteristics of existing CW LFM systems employing Doppler signal processing are compared. CW LFM can be used for continuous integrated study of the atmospheric boundary layer: Its thin dielectric structure, the movement velocity field, and the temperature profiles, and also to establish the influence of these factors on long-range troposcatter propagation conditions. Tables 1, figures 3, references 6: 3 Russian, 3 Western.

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# SELECTION OF FALSE INTERSECTIONS OF BEARINGS IN GONIOMETRIC SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 5, May 86  
(manuscript received 31 Oct 85) pp 16-18

[Article by A. N. Katulev and V. V. Tukhvatulin]

[Abstract] During an evaluation of the coordinates and parameters of moving objects, based on data from two of them spaced in the plane of the direction finders of goniometric systems, the necessity arises for a selection of true and false points of the intersections of bearings (IOB). Present methods for solving the selection problem, based on measuring the elevation angle of the IOB and the inclusion of a third direction finder, in some cases for a number of reasons do not satisfy the developers of information systems. The present article proposes a kinematic information criterion for selection of true and false points of intersection of the bearings of gonimetric systems and conditions for its applicability are presented. Figures 4; references: 3 Russian.

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CSO: 1686/282

ANALYSIS OF NOISE IMMUNITY OF ADAPTIVE ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian No 5, May 86  
(manuscript received 27 Dec 85) pp 75-77

[Article by V. S. Ivantovskiy]

[Abstract] The gain factor in a circuit for negative correlation of feedback (NCF) is a most important parameter, which has a substantial effect on the noise immunity of adaptive antenna arrays. Analytical expressions are obtained for calculation of the signal-(interference + noise) ratio at the output of such an array. The finite quantity of the gain factor normalized to the level of internal noise in the NCF circuit of a practicable device is taken into consideration. The quantitative demands on the magnitude of the gain factor are determined. Figures 2; references 8: 6 Russian, 2 Western.

6415/12955  
CSO: 1860/282

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SYNTHESIS OF APERTURE USING FAST FOURIER TRANSFORM ALGORITHMS

Moscow RADIOTEKHNIKA in Russian No 5, May 86  
(manuscript received 14 Oct 85) pp 85-86

[Article by A. F. Churzin]

[Abstract] An analysis is made of signals modelling the earth's surface which are reflected from a collection of point scatters. A signal reflected from a point scatterer, at the output of an analog-to-digital converter of a radar station with synthesis of the aperture and digital processing of a signal which has the form of a sequence of samples is involved. A two-state digital signal processing algorithm (considered in a 1982 article by V. B. Steynshleyger and others for synthesis of an aperture for lateral scanning) is investigated, including the reason for its employment of a fast Fourier transform with matched filtration in synthesis of the aperture.

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## RESONANCE EFFECTS IN RADIOTHERMAL EMISSION FROM WATER SURFACE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 4, Apr 86 (manuscript received 5 Aug 85) pp 379-383

[Article by V. Ye. Gershenzon, V. G. Irisov, Yu. G. Trokhimovskiy and V. S. Etkin, Institute of Space Research, USSR Academy of Sciences]

[Abstract] Radiothermal emission from the sea surface is analyzed as a two-dimensional problem of diffraction with absorption and scattering, according to Kirchhoff's law and the Poynting vector, for a plane electromagnetic wave propagating parallel to a plane water surface with ripple. Periodicity of the surface ripple is a crucial stipulation allowing, without restriction to a small and shallow surface, replacement of integral equations which relate incident fields and their normal derivatives at the air-water boundary to scattered fields in both media with matrix equations which relate Fourier series coefficients of fields and their derivatives at the boundary to amplitudes of discrete scattered modes. Numerical solution for a sinusoidal surface ripple, with the method of small perturbations only selectively applicable, has yielded the increment of emissivity as a function of the ratio of ripple period to wavelength at various scattering angles and as a function of the scattering angle for various relative ripple periods and amplitudes. Both functions have sharp peaks with maxima characterizing resonance. A comparison with experimental laboratory data indicates a need to include the second and third harmonics of the surface profile as well as a correction for geometrical three-dimensionality of the problem. Figures 5; references 7: 5 Russian, 2 Western.

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CSO: 1860/280



## FLUCTUATIONS AND WIDENING OF BEARING ANGLE OF SHORT RADIO WAVES ALONG RADIO ROUTES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 4, Apr 86 (manuscript received 10 Oct 84) pp 395-400

[Article by A. V. Gurevich and Ye. Ye. Tsedilina, Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, USSR Academy of Sciences]

[Abstract] Propagation of short radio waves through the ionosphere with multiple scattering is considered, scattering in the horizontal plane resulting in a wider beam with azimuthal distortions and bearing angle fluctuations. The theoretical analysis of this problem is based on the intensity distribution function  $f(Q, z, \phi, \alpha, \beta)$  characterizing a beam of short waves in a system of spherical coordinates  $Q, \phi$  ( $R_0 Q$ - distance along the beam axis,  $R_0$ - radius of the earth,  $\phi$ - azimuth angle) and vertical coordinate  $z$ , with  $\alpha$  denoting the inclination angle to a  $z = \text{const}$  plane and  $\beta$  denoting the declination angle to a  $\phi = \text{const}$  plane. The vertical  $(\alpha, z)$  intensity profile, with respect to adiabatic invariants and oscillation phase correspondingly, is assumed to be sufficiently smooth for negligible diffusion. The partial differential equation describing the horizontal  $(\phi, \beta)$  intensity profile is formulated generally and then simplified for an ideally spherisymmetric ionosphere. A comparison of the analytical solution for beam widening, bearing angle fluctuations, and mean bearing shift with experimental data obtained by V. I. Novozhilov and S. M. Sobolev (GEOMAGNETIZM I AERONOMIYA Vol 18, 1978) indicates a fair agreement. Figures 1; tables 3; references: 7 Russian.

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CSO: 1860/280

# CALCULATION OF ENERGY BALANCE BETWEEN PLASMA AND WAVE TAKING INTO ACCOUNT NONPOTENTIALITY OF WAVES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 4, Apr 86 (manuscript received 22 Oct 84) pp 401-407

[Article by M. G. Gelberg and A. V. Volosevich, Mogilev State Pedagogical Institute]

[Abstract] The energy balance between a plasma and a wave is calculated, taking into account nonpotentiality of the electric field and the effect of this nonpotentiality on the increment of wave amplitude in a ionospheric plasma. The interaction of plasma and wave is described by a system of equations which consists of an equation of motion for each kind of charged particles in accordance with the quasi-hydrodynamic theory and a corresponding equation of continuity for each in addition to three applicable Maxwell field equations. The equations of continuity and the field equations are linearized, assuming a small deviation from steady state, whereupon a rotational electric field is added to the potential one. For calculating the energy transfer and the energy loss, are first determined the electric field components respectively parallel and perpendicular to the magnetic field. The effect of nonpotentiality on the energy balance is then evaluated at frequencies and velocities characteristic of the ionospheric E and F layers, considering also the dispersion law for waves in these layers. The effect of nonpotentiality is found to be more appreciable in the F layer and particularly significant in the case of waves propagating at angles  $\phi > \sin^{-1}(\nu_e/\omega_{He})$ . Tables 1; references 3: 1 Russian, 2 Western.

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CSO: 1860/280

VHF-RADIO RECEIVER WITH PHASE-LOCKING AUTOMATIC FREQUENCY CONTROL

Moscow RADIO in Russian No 5, May 86 p 36

[Article by I. Pogartsev]

[Abstract] A radio receiver with phase-locking automatic frequency control has been designed and built for reception of radio broadcasts in the 65.8-73 MHz frequency band. Its principal features are a low supply voltage and a high thermal stability. It consists of a WAI antenna, an input stage tuned to the center frequency of the VHF band by an LC filter, an RC coupling circuit, a mixer with parallel-opposing diode pair, a multivibrator heterodyne on two transistors with voltage stabilization at their collector junctions and with a variable capacitor for tuning to half the signal frequency as well as a varactor diode for automatic frequency trimming, and a d.c. amplifier on two transistors with a diode and two resistors across the input. The phase-locking automatic frequency control loop is formed by a resistor which transmits voltage from the amplifier output to the heterodyne varactor diode. A ladder filter formed by the collector-base capacitance of one of the amplifier transistors and two RC circuits stabilizes the frequency tracking system. The frequency tracking and thus frequency modulating signal also proceeds through a predistortion circuit to the audio amplifier. Thermal stability is ensured by making all voltages which balance the d.c. amplifier change in the same direction and proportionally upon a change of temperature, also additionally by means of an extra resistor and a negative feedback limiting the voltage gain in the d.c. amplifier. The receiver operates with a 6 V power supply. Its mounting and alignment are very simple. Such a receiver was tested in the Sverdlovsk oblast and found to pick up programs of local VHF radio stations with a high degree of stability. Figures 2.

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'FOTON-234' INDUSTRIAL RADIO TELEVISION SET

Moscow RADIO in Russian No 5, May 86 pp 38-40

[Article by Ye. Girgoryev, A. Gordeyev, V. Levin and B. Strelets, Simferopol]

[Abstract] Controls in the 'Foton-234' set include, in addition to a television on-off switch and a loudspeaker on-off switch, also image brightness and contrast control, sound-track automatic gain control and loudspeaker automatic frequency control, with hookup either to a magnetic sound recorder or to earphones. The power supply with chopper delivers stabilized d.c. voltages to the television, which is galvanically isolated from the a.c. power line. It first converts rectified line voltage into high-frequency pulses of rectangular form and with adjustable repetition rate, and then converts these pulses into a constant voltage. It consists of a rectifier bridge, a trigger, a stabilizer, a protective device, a blocking oscillator with isolation transformer, a converter, and a filter array including an LC interference suppressor. The article, begun in RADIO Nos 2-3, 1986, is now concluded. Figures 2.

2415/12955

CSO: 1860/300

## FEATURES OF THREE-PROGRAM BROADCASTING

Moscow RADIO in Russian No 6, Jun 86 pp 29-30

[Article by G. Skrobot, Moscow]

[Abstract] In the USSR three-program wire broadcasting system the first channel transmits audio-frequency signals (50-10,000 Hz) and the other two transmit AM signals at high carrier frequencies (78 kHz, 120 kHz). Important features of such a broadcasting system are adequate signal power, which requires the proper supply voltage levels and the availability of amplifier substations as well as minimum attenuation along the lines. Good reception, meanwhile, depends on the receiver design as well as on its location and hookup. A set of standards and recommendations has been developed for both receiver and the transmission system, the latter including an auxiliary second low-frequency channel without amplification. Tables 2.

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## INTEGRATED MICROCIRCUITS FOR REMOTE CONTROL

Moscow RADIO in Russian No 6, Jun 86 pp 48-52

[Article by V. Plotnikov, Moscow]

[Abstract] Two integrated-microcircuit chips have been designed and are already produced commercially for remote control of consumer electronic appliances, specifically radio and television sets, over an infrared communication channel. They are the KR1506KhL1 transmitter chip and the K1506KhL2 receiver chip. On the transmitter side light-emitting diodes with high pulse power rating encode information in time intervals between short infrared radiation pulses. On the receiver side these pulses are converted into electric signals and these are amplified before they form control voltages for turning on or off, program selection, loudness, brightness, timbre regulation over four analog levels. Each control signal has a work length of 10 bits, 4 address bits and 4 command bits. Each is generated from 14 infrared radiation pulses with pulse-interval modulation. Interference is suppressed by amplitude gating by means of a preamplifier with automatic gain control and by time gating on the basis of synchronous reception with use of a decoder. The transmitter chip has an interlock for prevention of jamming and damage when two or several buttons are pressed simultaneously, and has protection against contact jitter. It can operate in four different modes, with both inputs connected to the "+" terminal or to the "-" terminal of the power supply or with either connected to the "+" terminal and the other connected to the "-" terminal respectively. The transmitter chip contains a push-pull input stage, a selectro switch with indicator light (light-emitting diode), and a power amplifier on three transistors loaded by three infrared light-emitting diodes, all transistors being closed in the absence of an input signal. Continuation of the article will follow. Figures 4; tables 2.

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CSO: 1860/304

## ECONOMICAL POWER PACK

Moscow RADIO in Russian No 5, May 86 pp 24-26

[Article by G. Kudinov and G. Savchuk, Taganrog]

[Abstract] A laboratory prototype of an efficient and compact power pack has been designed and built which features smooth voltage regulation over the 0-24 V range under a load of up to 1 A, with losses on regulation and rectification not exceeding 7 W. It consists of a switched tracking prestabilizer (1 trinitistor, 3 plain transistors, 1 unijunction transistor, 2 optrons with photodynistor each) and a continuous stabilizer (1 transistor pair, 3 single transistors). Additional circuit components include 8 diodes, 7 capacitors, 21 resistors. Both stabilizers are packaged inside a duralumin box also serving as heat sink for the transistor pair. The power pack requires a 100 W transformer for hookup to a 220 V - 50 Hz power line. After design modifications such as use of larger power diodes and transistors with better heat dissipation, one can increase the stabilizer load rating up to 5 A. Figures 1.

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DIGITAL COLOR TELEVISION SYSTEM WITH COMBINATION CODING

Moscow TEKHNIIKA KINO I TELEVIDENIYA in Russian No 5, May 86 pp 30-34

[Article by N. V. Ignatyeva, N. A. Malinkin and Yu. M. Titov, Leningrad Institute of Electrical Engineering imeni V. I. Lenin]

[Abstract] An experimental color-TV coding system is proposed, with a rigorous algorithm of combination coding based on statistical tests of images in the real ("portrait") class. The rule for combination coding of color video data was synthesized on a 'Minsk-32' digital computer according to the ORTSD program in the ORT.P mode, this program also yielding the r.m.s errors as well as the first approximations to entropy and redundancy. For verification of the results and design of the appropriate encode-decoder set, and experimental digital color television system was assembled with hardware of an automatic television complex and an array of discrete light filters from a TATSI-4 analyzer in addition to a normalizer module. Tests were performed with combination coding and with pulse-code-modulation for comparison, using an electronic generator of a discrete uniform-brightness field, with spatial image distortions during transmission of video data over both luminance and chrominance channels measured in each case. Based on the judgment of 23 expert viewers (professionally unbiased men and women of various ages), a pulse-code-modulation image and a combination-code image with half the data volume differ negligibly in quality, each being of worse quality than an analog image. Figures 3; references: 8 Russian.

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CSO: 1860/291



UDC 621.397.621-181.4

MINATURE BLACK AND WHITE TELEVISION SETS

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 86, pp 19-27

[Article by D. P. Brilliantov]

[Abstract] Soviet industry has produced 21 different portable black and white TV models in 'Elektronika', 'Shilyalis', 'Yunost' and 'Sapfir' series in variants designed for European, American and British TV standards as well. The weights range from 1.8 kg without the power supply for the smallest models to 8.6 kg for the largest (Yunost-405D and -406D) with dimensions of from 165 x 95 x 215 mm to 392 x 290 x 297 mm. This survey paper summarizes and discusses the designation codes, specifications of the sets and CRT tubes as well as the general block diagrams, tuner designs and many specific features of the newer 'Elektronika-11' and 'Elektronika-450' using IC's. All of the sets described here use CRT's and no mention is made of LCD screens, microprocessor controls or other recent technological innovations. Figures 5; references: 4 Russian.

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INTERNATIONAL RECOMMENDATION FOR DIGITAL VIDEO RECORDING. CODING OF AUDIO DATA, CONTROL TRACK, SOUND TRACK AND TIME CODE TRACK

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 4, Apr 86, pp 42-47

[Article by V. A. Khleborodov, expert with the Joint Temporary Working Group 10-11/4 of the CCIR (All-Union Scientific Research Institute for Television and Radio)]

[Abstract] This paper continues the companion paper [TEKHNICA KINO I TELEVIDENIYA, 1986, No 3, pp 39-45] by the same author dealing with the first five sections of the draft of CCIR Recommendation "Digital Video Recording" prepared by the Joint Temporary Working Group 10-11/4. This continuation details the contents of the remaining four sections of the recommendation, spelling out all the specifics of the draft: the audio processing with the configuration of the audio data words, control interface words, processing control words and user control words. Tables and charts illustrate the conversion of the words to bytes, the structure of the audio data block, the operating modes of the two interface channels and the generation of the interface control words. The configuration of the sound sectors on the recording tape is diagrammed. The waveform and positioning of the pulses on the control track are also diagrammed in detail. A complete block diagram is given for the processor of a 4:2:2 standard digital video recorder. This draft of the international "Digital Video Recording" recommendation completes the development of the three part digital standard of the CCIR, including the base recommendation 601 "Coding Parameters for Digital Television Studios" and the recommendation "Interfaces for Individual Digital Video Signals in the 525-Line and 625-Line Television Systems". Figures 7; references 5: 2 Russian, 3 Western.

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# FORECASTS OF SATELLITE TELEVISION REPEATER DEVELOPMENT

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 4, Apr 86, pp 65-66

[Article by F. R. Bushanskiy]

[Abstract] The continuing stable trend towards increased size and weight of satellite TV repeaters is evidenced by the Japanese BS-3 planned for 1990 with an increase of 200 kg over the weight of the BS-2 as well as the planned 'Intelsat VI' weighing 2,000 kg. Such increases are necessitated by the increase in the transmitted power, antenna size and number of TV channels. Since the payload capacity of orbital delivery vehicles is limited, the need for an alternative to these increases is acute. It planned that the design work on a space station will be completed by 1987 and the station will be assembled in a near-earth orbit in 1992 with shuttles delivering all of the components to the low orbit. The station will then be boosted into a geostationary orbit at 36,000 km. The geostationary platform will have solar panels capable of supplying the 75 kW station power requirements and the base will be serviced by a crew of six to eight persons. The tour of duty on such a platform will be three to six months. This approach circumvents the problem of satellite overpopulation when a large number of relatively low power TV repeaters are inserted in geostationary orbits. Despite the problems yet to be surmounted, the geostationary TV broadcasting platform will be placed in continuous service at the beginning of the 21st Century. Figures 2; references: 4 Western in Russian translation.

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CSO: 1860/265

UDC 778.53:771.531.351

NEW 35-MM MOTION PICTURE CAMERA

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 86, pp 4-6

[Article by Ye. G. Bychko and V. F. Gordeyev, Moscow Motion Picture Equipment Design office]

[Abstract] The Kinor-35S motion picture camera has been improved at the Moscow Motion Picture Equipment Design Office: the new Kinor-35N (9KSN) is a light-weight model with a film capacity of 150 m or 300 m, suitable for shoulder-held operation. The Kinor-35N has a built-in exposure meter that can also be replaced with a TV camera, connected with a cable to an 11-cm monitor or an external video recorder. The camera has electronic control circuitry for the film transport motors, for visual and aural indication of synchronization of the camera, for shutter control as well as for crystal control of the frame rates at 24 and 25 frame/sec. Accessories also allow for a variable 8 to 32 frame/sec rate and camera synchronization from the 50 Hz power mains as well as from the vertical sweep frequency of the TV circuit. The camera weighs 12 kg, has a picture image stability of no worse than 0.015 mm and an aperture angle of the mirror shutter of 180°. Industrial production of the camera was started in 1986 by the 'Moskinap' plant and the full equipment complement of the camera when it is series produced will be specified by the motion picture studios. Figures 2.

8225/12955

CSO: 1860/265

## ACOUSTICAL-OPTICAL RECORDING OF VARIABLE WIDTH PHOTOGRAPHIC SOUND TRACKS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 4, Apr 86, pp 7-9

[Article by K. P. Naumov, V. A. Savin, L. G. Tsifrinovich and L. I. Ezrokh, Leningrad Optical and Mechanical Association, Central Design Office for Cinematography of the Ekran Scientific Production Association]

[Abstract] A collimated light beam from a laser impinges on a slot and the resulting light field is projected by a cylindrical lens onto the aperture of an acoustical-optical modulator; acoustic waves are excited in the sound channel of the modulator by an FM generator controlled by the signal being recorded. The light field, now stopped down by the acoustic waves, is focused onto a photographic film recording track by another cylindrical lens. The width of the track is governed by the switching time of the electro-optical shutter to which the pulse width modulated voltage derived from the signal being recorded is applied. One edge of the recorded line is fixed while the other varies with the modulating signal. The relevant analytical expressions for the system performance are given; an experimental test is described. An LG-52-3 laser (2 mW at 0.63 micrometers) and an ML-201 acoustical-optical modulator with a center working frequency of 80 MHz were used. The center frequency of the FM generator was 77 MHz; the frequency deviation for the maximum recorded signal was 1 MHz; the exciter and amplifier driving the piezoelectric transducer of the modulator generated about 10 volts in a band of 76 to 78 MHz. The measured light writing line parameters were: maximum length of 1.95 mm, width of 10 micrometers and line illumination of  $10^6$  lux. The recorded signal bandwidth (3 dB down) was 100 kHz and the harmonic distortion was 2% between 1 kHz and 10 kHz. Figures 2; references: 8 Russian.

8225/12955

CSO: 1860/265

UDC 621.382.3

STATISTICAL CHARACTERISTICS OF THE ELEMENTS OF AN EQUIVALENT CIRCUIT OF  
HIGH-FREQUENCY BIPOLAR TRANSISTORS

Moscow RADIOTEKHNIKA in Russian No 5, May 86  
(manuscript received 11 Sep 85) pp 45-47

[Article by G. V. Utochkin]

[Abstract] The statistical characteristics of radio elements, among them transistors, are required in order to perform probability-statistical estimates on electronic equipment (EE). For this purpose the statistical characteristics are obtained for six of the elements of the equivalent circuit of a group of 100-200 units of various types of germanium and silicon transistors used in high-frequency units for discrete and integrated performance. The resulted data, presented in three tables, are analyzed. These tables make it possible to conduct EE probability-statistical estimates on a number of transistors listed in the tables by type and on transistors the statistical characteristics are not known. It is necessary to obtain the mathematical expectation of the parameters of such transistors from reference books or technical data. References: 4 Russian.

6415/12955  
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PROBLEMS IN DATA TRANSMISSION OVER AUTOMATED DECAMETRIC-WAVE RADIO LINES

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 23 Aug 85) pp 14-18

[Article by Yu. F. Pelegov, S. I. Turetskiy and V. P. Repkin]

[Abstract] Although decametric-wave radio lines offer the advantages of easy hookup between points and simple arrangement of conferences as well as communication with mobile terminals up to 4000 km away, at transmission rates up to 1200 bit/s with 90-95% reliability and with the probability of bit error not larger than  $10^{-5}$ , there are several problems which have so far prevented their wider use for discrete-data transmission. These are needed for a very high signal-to-noise ratio ensuring adequate fidelity as well as reliability, unavailability of commercially produced modems for 600-2400 bit/s operation, difficulty of normalizing channel parameters like those of standard tone-frequency channels, and low level of overall automation in trunk networks. The first problem is either difficult or impossible to solve in official networks, lack of suitable modems necessitates the use of single-band frequency-telegraph equipment, while the last two problems prevent hookup of radio channels to wire communication channels and merging them all into a single automatic network with common controls. The problem of increasing the interference immunity, thus both fidelity and reliability of data transmission, is analyzed theoretically on the basis of the Gilbert model and using the results of measurements made in a 4000 km long latitudinal radio line transmitting data at a rate of 1200 bit/s. A method of protection against fading, a principal form of interference, is proposed which utilizes a characteristic feature of decametric-wave channels, namely the existence of time intervals available for high-fidelity data transmission. The method involves compounding of data packets, for transmission within those intervals, and will work alone or in combination with automatic protective tripping. Its efficiency with use of a Gilbert modem is evaluated on the basis of probability calculus, with histograms of mean error probability during typically 5 min long communication periods and in typically 0.4 s long data packets. Figures 5; references 12: 10 Russian, 2 Western in Russian translation.

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CSO: 1860/297

## AUTOMATIC SHORT-WAVE RADIO COMMUNICATION SYSTEM WITH RADIO RELAY

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 5 Nov 85) pp 19-21

[Article by O. V. Golovin]

[Abstract] Reliable direct short-wave radio communication can be easily established within hardly otherwise accessible territorial zones 200-500 km wide between radio stations, as has been demonstrated in various regions of Siberia from the West to the Far East and in some Arctic islands. Short-wave communication between radio stations so far apart is difficult to establish, however, and requires the use of radio relays. Such a radio relay must be placed outside the given zone, 2000-2500 km away, so as to ensure the necessary quality of transmission with the minimum signal-to-interference ratio. Studies made at the Moscow Institute of Electrical Communications Engineering indicate that high reliability and interference immunity as well as efficiency of zonal radio communication at decametric wavelengths are attainable by optimal lengthening of the radio lines and by use of medium or high frequencies rather than low frequencies within this wave band, for better frequency control and interference suppression. The power of the radio stations can then be reduced, while the relay radiation power is increased. Reception is further enhanced by use of pencil-beam antennas. Use of a single carrier frequency for communication between a multichannel transmitter and several receivers within the zone results in a more centralized frequency assignment and a more economical distribution of available spare frequencies. A radio relay should be provided with weather forecasting equipment, while the radio stations it serves should have centralized adaptive controls. The most difficult problem, namely automation of processes in the radio relay receiver and of adaptive control, is now solvable with the aid of microelectronic devices and digital techniques. Electromagnetic compatibility will be enhanced by orienting the radio relay with its transmitter nearer to and its receiver farther from the territory of the zone it serves. It is finally feasible to link several territorial zones into a single much wider one by interfacing the respective radio relays with multichannel communication links. Figures 1; references: 3 Russian.

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## AUTOMATION OF ENERGY-CRITERIA DESIGN OF DECAMETRIC-WAVE RADIO LINES

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 31 Jul 85) pp 27-29

[Article by A. N. Bashmakov, N. N. Bashmakov and B. I. Kuzmin]

[Abstract] Although there is no universal method of estimating the quality of radio communication channels, their reliability serves most often as its measure. The reliability as quality criterion, defined as the probability of a connection at any random frequency selected within the usable band and with an interference immunity not lower than minimum required, is a function of the average signal power during a communication period and thus involves both signal and interference power as energy criteria. Design of decametric-wave radio lines on this basis reduces to calculation of the probability of failure-free operation for all transmitter and receiver components. Considering the diversity of components and of their reliability characteristics, including different causes and modes of failure, an algorithm of this calculation has been devised which is programmable for computer-aided design of decametric-wave radio lines. Figures 2; references: 8 Russian.

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## RADIO SERVICES FOR MERCHANT MARINE

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 13 Aug 85) pp 9-13

[Article by Yu. S. Atserov and K. A. Semenov]

[Abstract] Radio services available to the merchant marine cover: 1) communication at metric wavelengths, between vessels or between vessel and shore on open and closed roadsteads within a harbor, 2) short-distance communication at metric wavelengths (156-162 MHz) or hectametric wavelengths (0.5-3 MHz) as well as long-distance communication at decametric wavelengths (3-30 MHz), between vessels or between vessel and shore, 3) communication at hectometric wavelengths, between vessels and harbors within a sea basin, 4) communication over trunk line, principally at decametric wavelengths, between radio centers on shore. Satellite radio communication is coming into use, within the framework of the international INMARSAT system as well as of the COSPAS-SARSAT system in which the Soviet Union participates with the United States, Canada, and France. Alongside radio communication has also been developed radio navigation, earlier hyperbolic pulse and then hyperbolic pulse-phase systems being now replaced by satellite navigation systems with an about 1000 km optimum orbiting altitude. Marine radar is another development, recently enhanced by automation with the aid of a new generation of computers on IC chips. The outlook for the future is further improvement of satellite communication systems, introduction of digital dialing and adaptive linkage, further automation particularly of metric-wave and decametric-wave equipment, development of facsimile communication, redesign and automation of the hookup process, and establishment of a global technical maintenance service. Figures 2; references: 8 Russian.

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DEVICE FOR ADAPTIVE FREQUENCY CONTROL OF DECAMETRIC-WAVE RADIO COMMUNICATION  
IN MOBILE MARITIME RADIO SERVICE

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 23 Jul 85) pp 32-34

[Article by K. A. Semenov, V. A. Markov and G. Ye. Rumyantsev]

[Abstract] A device for adaptive frequency control of radio communication has been built, its specific purpose being to ensure reliable reception of Class FIBBN teleprint signals transmitted over decametric-wave channels of mobile maritime radio service. The device consists of a shore set and a ship set, each between the respective transmitter and multichannel receiver. Each set consists of three modules. The first module contains a channel quality analyzer which indicates the signal-to-interference ratio and a receiver-frequency selector. The second module contains an automatic transmitter-frequency changer which follows instructions from the first module. The third module couples the first module to the start-stop controls for the printer reels. The device can automatically select the receiver frequency which is optimum in terms of the extremizing and threshold setting algorithm, for messages transmitted simultaneously at several frequencies from shore to ship, it can automatically select the optimum receiver frequency and tune not only the receiver on board but also the transmitter on board to that frequency. It can also adaptively select the optimum receiver and transmitter frequencies for radio equipment on board and on shore. For an experimental verification of feasibility and evaluation of performance, this device was tested along three routes: Leningrad-Cuba route (124 test runs in February 1981), Leningrad-Greece route (67 test runs in December 1982), and Leningrad-Australia route (329 test runs in summer 1984). Figures 2; tables 1; references: 4 Russian.

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## SUPPRESSION OF INTERFERENCE IN MULTIBEAM SHORT-WAVE ANTENNA ARRAY

Moscow ELEKTROSVYAZ in Russian No 5, May 86  
(manuscript received 22 Aug 85) pp 21-22

[Article by L. S. Kazanskiy and S. V. Muromov]

[Abstract] A multibeam decametric-wave antenna array is considered, a ring of vertical dipoles not azimuthally oriented but uniformly spaced in a circle at a radius of 15 m for the 3-10 MHz frequency band or 7.5 m for the 10-30 MHz frequency band. The dipoles are matched to their feeders, there is almost no coupling between the dipoles ( $SWR \leq 0.8$ ) over the entire frequency range, and the feeders are connected to a phasing ring at points matching the azimuths of the major lobes of the antenna radiation pattern. This phasing ring is also connected to the antenna switch and the latter is connected to two summators, to each directly as well as through two parallel sets of phase shifter and attenuator in series. The two summators feed each a receiver, with microcomputer-aided automatic feedback to or with manual control of the interference suppressor consisting of that antenna switch and the two summators. Figures 1; references 2: 1 Russian, 1 Western.

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## USING SMOKESTACKS OF ELECTRIC POWER PLANTS AS ANTENNA TOWERS FOR RADIO COMMUNICATION IN POWER SYSTEMS

Moscow ENERGETIK in Russian No 4, Apr 86, pp 28-30

[Article by K. A. Tatsis, engineer, UzSSR Ministry of Power System]

[Abstract] Installation of VHF antennas and radio relay antennas on top of 60-300 m tall smokestacks of thermal electric power plants running on fossil fuel offers the advantage of lengthening the range of stable radio communication with mobile or other stationary radio stations and lengthening the distance between relay points with an attendant saving of equipment. The main problem is ensuring the necessary antenna radiation pattern in the horizontal plane, which requires correcting for distortions by the smokestack cross-section and by electrical lighting or other fixtures mounted on the landing. The next problem is suppressing electromagnetic interference from outdoor distribution equipment. The location of antenna and feeder must be selected so as to avoid their contamination by aggressive substances in the smoke. Various layout schemes have been devised, the configuration depending on the stack height and on the attenuation in the antenna-waveguide channel. Mounting the antenna 10-30 m below the top marker is recommended for protection against pollutants. In the UzSSR power system one finds collinear or other broadband FM radio station antenna and few-channel radio relay antennas mounted on the upper or next to upper landing 60-200 m or 300 m above ground, usually with 75 ohm coaxial cables and electromagnetic shields. When a circular radiation pattern is required, three or four antennas are mounted in an array respectively  $120^\circ$  or  $90^\circ$  apart. The exact location is established on the basis of signal measurements. Special distribution and matching transformers are needed for coupling several antennas to a common feeder. The performance of a collinear antenna installed in 1978 on a 200 m tall smokestack has in no way deteriorated so far, neither has the performance of radio relay antennas installed on smokestacks 8-10 years ago. Figures 1.

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## INSPECTION OF COMMUNICATION EQUIPMENT PERFORMANCE WITH AID OF 'ELEKTRONIKA-60' MICROCOMPUTER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 6, Jun 86 (manuscript received 4 Oct 85) pp 43-47

[Article by A. A. Akayev and T. M. Muratov, Frunze Polytechnic Institute]

[Abstract] The complexity of modern communication equipment with channel multiplexing, especially when homogeneous computer systems are used for data acquisition and processing, makes its adequate inspection for performance control possible only with the aid of microprocessors and microcomputers. Such an inspection system on the basis of an 'Elektronika-60' microcomputer has been developed for multiplexing equipment in automatic telephone exchanges. The microcomputer has a common-trunk architecture so that all peripheral users' equipment is connected to it through parallel and sequential interfaces. Communication between computation module and inspection objects proceeds logically and physically at two levels: at the digital level with a parallel input/output interface, at the analog level for primary processing of input data with an analog-to-digital converter, a high-impedance analog multiplexer, and a high-frequency filter. The algorithm of inspection performance was programmed for the 'Elektronika-60' microcomputer. Figures 3; references: 3 Russian.

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CSO: 1860/299

INCREASING IMMUNITY OF SIGNALIZATION-CENTRALIZATION-INTERLOCKING DEVICES

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 4, Apr 86, pp 21-22

[Article by V. I. Yesyunin, deputy chief, Signalization and Communication Service, Gorkiy railroad line]

[Abstract] Most common failures of railroad signalization-centralization-interlocking devices occur as a result of shorts in relay contactor circuits, such a short along any one track producing a very large potential difference between rails of different tracks. This can be avoided by placing the single-phase transformer substation with all accessories and the signalization equipment on the same side of a track or, if that cannot be done, grounding them to the same rail. The effectiveness of this scheme is demonstrated in the case where the single-phase transformer substation with its relay box and the main single-phase transformer with its relay box are on different sides of a track. This scheme also demonstrates, however, that the Guiding Instructions with regard to overvoltage protection of railroad signalization-centralization-interlocking equipment and particularly automatic oil circuit breakers urgently need to be revised so as to match actual conditions in the field. Figures 1.

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## CONDITIONS FOR TRANSMITTABILITY OF SPEECH DURING JOINT OPERATION OF RADIO STATIONS ZhR-U AND RN-12B

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 5, May 86, pp 8-10

[Article by A. V. Yelizarenko, senior instructor and I. P. Knyshev, candidate of technical sciences, assistant professor, Kharkov Institute of Railroad Transportation Engineers]

[Abstract] Transmission of speech during joint operation of FM radio stations ZhR-U and RN-12B over a common channel is problematic, owing to the different frequency separations between adjacent channels in each and consequently different pass bands of their receivers. In communication from an RN-12B transmitter to a ZhR-U receiver, decreasing the frequency deviation of transmitted signals will decrease the signal output power of the receiver. The worst case is, however, communication from a ZhR-U transmitter to an RN-12B receiver, on account of both amplitude and phase distortions caused by mismatch of the receiver amplitude-frequency characteristics and the spectrum of transmitted signal. An analysis of these distortions on the basis of FM theory and measurements, with exact tuning of transmitter and receiver to the same carrier frequency, indicates that the coefficient of nonlinear distortions can reach 20%. Such a high level is, however, not likely to be reached under practical operating conditions. Tests conducted by 8-10 experts without speech or hearing impairment but representing a diversity of response characteristics have revealed that speech can be transmitted with Class 1 (90%) intelligibility without causing listener strain. This is explainable by a much smaller than maximum permissible frequency deviation of transmitted voice signals and by a negligible effect, up to a limit, of a larger ripple factor on the intelligibility of speech sounds, only the audibility threshold being raised by the masking effect of harmonics. The quality of speech transmission between two such radio stations will thus depend only on external factors such as distance between them, signal power, and interference. Figures 7.

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UDC 656.256:656.254.153.29

## REMOTE SWITCHING AND MONITORING OF TELEVISION CHANNELS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 5, May 86, pp 25-27

[Article by L. V. Grigorovich, senior electrician and P. D. Kostenok, engineer, Automation, Remote Control and Communication Laboratory, Odessa railroad line]

[Abstract] The reliability of operation of traffic control centralizing equipment for the Odessa railroad line has been improved by addition of a standby channel to the existing TV channel of the code line. Both channels connecting the main post is the traffic control center of some station A and the repeater post in the electric signaling and switching center of some station B. Manual switching of channels in either station automatically actuates both modulator and demodulator in that station as well as the dial tone transmitter in that station and the dial tone receiver in the other station. A frequency separation of 800 Hz between dial tone transmitter and receiver in each station, both built with a 1600 Hz oscillator, is established by means of a capacitor in series with a switch across the transmitter. The sequence of operations is the same for switching from main to standby channel and from standby to main channel. This system has been operating failure-free for two years along three segments of the Odessa railroad line. Figures 3.

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## RESULTS OF TESTS OF LINE SECTION EQUIPMENT OF BK-960-2 TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ in Russian No 6, Jun 86  
(manuscript received 27 Nov 85) pp 17-22

[Article by V. N. Parkhomenko, V. V. Lapin, O. G. Gedovius, A. M. Gerasimov and G. M. Aldoshina]

[Abstract] The development, linear tests, and the annual cycle of measurements of the basic parameters of a line section of the VK-960-2 transmission system manufactured by the Hungarian People's Republic are considered. The system is a modification of equipment described in ELEKTROSVYAZ, 1980, No 7, completed with regard for the proposals and remarks of the USSR Ministry of Communications. Some changes were made in the equipment because it was necessary to change the length of a section for remote feed from 108 to 196 km, and the length of a uniform part of the system from 280 to 392 km. The results of line tests showed that the modified version of the equipment basically meets the prescribed technical levels. Designed for the organization of 960 tonal frequency channels by type MKTS-4 cables with coaxial pairs 1.2/4.6 mm (1.2/4.4 mm), the BK-960-2 is chiefly used for reconstruction of main lines, equipment of the K-300 transmission system, and in individual cases for new construction of local main and trunk lines and on zone and main networks. As a result of the use of the BK-960-2 instead of the K-300 transmission system, the carrying capacity of long lines has increased by 3 times; the annual economic effect on one channel-kilometer amounts to 0.89 ruble; the period of the pay-back of expenditures during reconstruction is 3.9 years (standard period - 6 years); and the specific consumption of copper for the BK-960-2 consists altogether of 0.08 kg/channel/km, while for the K-300 it is 0.27 kg/channel/km. The following items associated with the BK-960-2 are considered in detail: basic parameters of system; line section equipment; devices for frequency-response equalization; stability in time of amplitude-frequency characteristics; device for automatic level control; noise immunity; devices for local and distant power supply; link between operators; and protection from external effects. Figures 6; references: 2 Russian.

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CSO; 1860/310

## RURAL COMMUNICATION CABLES WITH ALUMINUM-COPPER STRANDS

Moscow ELEKTROSVYAZ in Russian No 6, Jun 86  
(manuscript received 27 Jul 83) pp 23-25

[Article by V. V. Bystrov, Yu. A. Parfenova, L. G. Rysin and N. L. Sherman]

[Abstract] Cables with copper strands are widely used on rural communication lines. However, because the shortage of copper requires substitution of conductor materials, in the last 10 years intensive work has been done with respect to the use of aluminum, its alloys, and clad metal as conductors. Pure aluminum has not found use because of its nonsatisfactory physico-mechanical characteristics. Attempts to create rural communication cables with aluminum strands, for laying directly in the ground, did not succeed. The single-pair cables PRPPA 2 x 1.6 and VTSPA 1 x 4 x 1.6 were not introduced because of their insufficient operational reliability. The method of increasing the reliability of rural communication cables by lengthwise sealing of the core by hydrophobic compounds opened the possibility of creating cables with strands of new materials - aluminum-copper, i.e., an alloy of aluminum and copper (clad metal). Type BKSPZP and BKSPZPB 1 x 4 x 1.2 single-quad high-frequency cables with aluminum-copper strands and hydrophobic filling are described and their dimensions and electrical characteristics presented. These cables are intended for interstation communication lines on which transmission systems are installed with amplitude modulation and frequency division of channels in the spectra of frequencies up to 550 kHz, as well as transmission systems with time division of channels and pulse-code modulation in the spectra up to 2,000 kHz with the voltage of the remote power supply up to 350V direct current. The cables are laid under conditions which are not characterized by an increased electromagnetic effect, and in ground not susceptible to frozen ground phenomena. TSPZP6 and TSPZPB6 cables for subscriber lines of rural telephone stations are also described and their dimensions and electrical characteristics presented. The results of test operation of the various cables considered are given. Figures 2; references: 2 Russian.

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MEANS OF INCREASING THE RELIABILITY OF BAND-TYPE PROTECTIVE COVERS FOR  
COMMUNICATION CABLES

Moscow ELEKTROSVYAZ in Russian, No 6  
(manuscript received 25 Jan 85) pp 26-29

[Article by K. K. Nikolskiy and O. A. Lunev]

[Abstract] Various deficiencies of the protective covers for communication cables, as well as violations of technology and the use of materials which do not satisfy protective requirements, cause latent defects which in time lead to corrosion of the metal sheaths of the cables and to their withdrawal from service. The following items are considered in this connection:  
1) Types and basic dimensions of protective covers; 2) Specifications of protective covers; 3) Principles of acceptance; and 4) Methods of testing. The basic measures which must be realized in order to have uninterrupted operation of long line communication cables are: 1) Development and introduction of new receptors for insulated bitumens and bitumen compositions, which to the maximum degree conform to the requirements imposed with respect to insulating properties, adhesion, and longevity (including also inhibited bitumen composition); 2) Development of new technology for applying the first layer of bitumen composition or bitumen on the metal sheath, assuring continuity, the assigned thickness of the layer with respect to the perimeter and lengthwise, as well as good adhesion lasting during the course of the cable's use; Development of methods of objective monitoring of the condition of the metal surface of the cable sheath before deposition of the bitumen, compactness of the bitumen layer and its thickness, as well as the continuity of the paper and the plastic band along the structural length in the process of applying the protective cover; 4) Review of the current GOST 7006-72 with the object of introducing standards for the quality of protective covers; 5) Guarantee of 100% product inspection of the protective covers of cables delivered to communication enterprises; 6) Evaluation of corrosion state of communication cables in operation; 7) Designing and realization of protection for communication cables subjected to the action of corrosion processes; and 8) Repair of cables removed from service because of corrosion. Figures 2; references: 5 Russian.

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## LOW-POWER UHF FM RADIO

Moscow VESTNIK SVYAZI in Russian, No 3, Mar 86, pp 25-26

[Article by M. S. Landsman, chief, Rayon River Transport Administration Zone Laboratory, Ukrainian SSR Ministry of Communications and D. N. Vinnitskaya, senior engineer]

[Abstract] A low-power UHF FM radio station with a small coverage radius designed for filling in the "dead zone" of high-power radio stations in small populated regions is described. The radio was built by reconfiguring the video transmitter employed in the TRSA television repeater. The driver in the video circuit was replaced by a standard pulse-phase FM driver that is adjusted so that its frequency is nine times lower than the output frequency of the transmitter. The buffer amplifier of the TRSA transmitter is then tuned to the frequency of the FM driver. Two frequency doubling stages are converted to the tripling mode and set to the corresponding frequencies. The output stage is tuned to the UHF FM broadcast frequency. This modified system is now in use in the Ukrainian SSR. The operating currents and voltages of the transmitter are presented in a table. The electroacoustic indicators correspond to the existing standards for UHF FM broadcast. Figures 5.

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UDC 621.396.946:621.396.43

EMC CRITERIA AND CONDITIONS FOR SATELLITE AND RADIO RELAY COMMUNICATIONS  
SYSTEMS

Moscow ELEKTROSVYAZ in Russian, No 2, Feb 86  
(manuscript received 19 Nov 85) pp 28-31

[Article by S. V. Borodich]

[Abstract] Electromagnetic compatibility criteria for satellite and radio relay communications systems are outlined. Limitation of the power flux density on the ground created by the space facilities serving the fixed satellite service is analyzed. It is found that existing conditions for limiting the power flux density are not sufficient to satisfy EMC criteria for digital radio relay links. The importance of developing a model that describes the actual interference situation is stressed. Figures 2, references 5: 4 Russian, 1 Western.

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CSO: 1860/230

## PROBLEMS OF DEVELOPMENT OF LIGHTNING-RESISTANT CABLES

Moscow ELEKTROSVYAZ in Russian, No 2, Feb 86, p 34

[Unsigned article]

[Abstract] In spite of the appointment of the USSR Communications Ministry Scientific-Engineering Council in 1985, not enough is being done to develop lightning-resistant communications cables. More research on new materials (magnetic and conductive plastics) is needed, and the experimental base for studying cables remains deficient. The Scientific-Engineering Council has recommended that technical specifications for cables be established on the basis of an integrated approach to the effects of external electromagnetic fields from various sources, that the lightning resistance of existing cables be clarified, that experimental cable specimens be prepared and tested, and that schedules for the development and fabrication of such cables be defined during the 12th Five-Year Plan. The organizations involved are to compose a comprehensive testing program for the experimental specimens, and formulate proposals for the development and expansion of the experimental base.

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LIMITING ERROR OF TRACKING LIGHT OBJECT BY TRACKING TELEVISION SYSTEM

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 5 Jul 85, after revision) pp 22-26

[Article by V. I. Tislenko and Yu. V. Martyshevskiy]

[Abstract] Optimal Markov nonlinear filtering is used to synthesize the structure of an optimal television tracking system and analyze the potential accuracy in determining the coordinates of lighted objects by a dissector television tracking system over a wide contrast range with allowance for the nonstationary component of the dissector noise. The influence of the contrast of the lighted object on the accuracy with which its coordinates are determined is investigated. The random component of the trajectory of the lighted object is found to have a significant influence on the estimation accuracy. The nonstationary component of the dissector noise increases the coordinate error as the contrast of the lighted object increases. Figures 3, references 5: 4 Russian, 1 Western.

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PROBABILITY DISTRIBUTION OF INSTANTANEOUS FREQUENCY OF SUM OF SIGNAL AND  
NARROWBAND NOISE

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 8 Jul 85, after revision) pp 51-54

[Article by V. V. Blatov]

[Abstract] The probability density and distribution function of the normalized deviation of the instantaneous frequency of the sum of a signal and narrowband noise were measured experimentally. The upper and lower bounds of the variance of the probability density estimate are determined for multiples of the process in which adjacent samples are statistically independent, or in which the entire process is divided into groups that are statistically independent, with the frequency  $f/n$  fixed within the group. Experimental measurements in the short-wave band are described. The experimental findings agree well with the theoretical analysis. Figures 3, references: 6 Russian.

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SPATIAL SELECTION OF MULTIPLICATIVE INTERFERENCE IN MOBILE RADIO COMMUNICATIONS NETWORKS

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received, after revision, 22 Dec 84) pp 72-74

[Article by E. S. Golovin and Yu. Ya. Meremson]

[Abstract] The use of directional antennas for spatial selection of multipath signals in order to combat multiplicative interference in mobile radio communications systems is investigated. The performance of omnidirectional and highly directional antennas under multiplicative interference conditions is compared. It is found that directional antennas are most effective in networks in which the platforms travel along highways or railroads, because it is easy to match the maximum of the radiation pattern with the velocity vector, thus maximizing the suppression of multiplicative interference, and also because the probability is high that the maximum of the radiation pattern will coincide with the primary direction of arrival of the reflected waves and the direction of arrival from the direct wave from the transmitter. Figures 1, references: 2 Russian.

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OPTOELECTRONIC GALVANIC DECOUPLING DEVICES FOR COMMUNICATIONS EQUIPMENT

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received, after revision, 26 Jun 85) pp 82-84

[Article by Yu. R. Nosov]

[Abstract] Opto-isolators and optoelectronic integrated circuits used for galvanic decoupling in communications equipment are described. The AOD129A, KOD301A, KOL201A, AOD133A, AOD134AS, AOT101AS and BS, and AOD130A opto-isolators are described and compared. Opto-isolators that employ a piece of flexible fiber optic cable as the optical medium are analyzed. These devices are found to correspond to traditional semiconductor devices and integrated circuits in terms of overall requirements and resistance to external perturbing factors. References: 13 Russian.

6900/12955  
CSO: 1860/222

UDC 621.397.6:621.317.757+681.325.5-181.4

SIGNATURE ANALYZER

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 86, pp 47-54

[Article by V. Ya. Yefremov and M. P. Yermolayev, Technical Television Center  
imeni 50th Anniversary of the October Revolution]

[Abstract] Time and error detection reliability constraints preclude the use of conventional test equipment for the diagnosis of microprocessor systems. Signature analyzers, first developed by Hewlett-Packard in 1977, can process the long binary data flows from microprocessors, compressing them into short flows with a high degree of reliability in a format called a signature. A general description of signature analyzer design and operation is followed by specific details of a Soviet analyzer designed around K155 series IC's (plus two K176LA7 IC's). The maximum clock pulse frequency is 3 MHz, the input levels are TTL compatible, the minimum time between signature generation cycles is 2.5 microseconds, the current consumption from a 5 V supply is 1.3 A, the dimensions are 260 x 170 x 90 mm and the weight is 3.5 kg. An example is provided illustrating the application of the analyzer to the Hungarian built OL-622/1 single board microcomputer with detailed instructions for the conduct of the testing. Figures 9; references 10: 5 Russian, 5 Western in Russian translation.

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CSO: 1860/216

## ORGANIZATION OF DATA INPUT-OUTPUT IN MICROPROCESSOR SYSTEMS

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 4, Apr 86, pp 17-20

[Article by S. N. Trankov, engineer, Leningrad Institute of Railroad Transportation Engineers]

[Abstract] Three methods of organizing the data exchange between a microprocessor and a peripheral device are analyzed and evaluated. Input-output by program is initiated and controlled by the microprocessor. Input-output by interrupts is controlled by the peripheral device. Input-output by direct access to memory involves use of a HOLD signal disconnecting the microprocessor from the busbars while connecting the peripheral device to them. Owing to different speeds of microprocessor and peripheral device, most peripheral devices must be checked with a READY signal before data exchange can begin and the latter then proceeds in the synchronous mode with acknowledgment. Some peripheral devices such as light-emitting indicator diodes are always ready for data exchange so that the latter can proceed in the asynchronous mode. The software for many microprocessors includes a set of subroutines, called drivers, for data input from and data output to any standard peripheral device. Data input-output by direct access to memory is most time efficient of all three methods. Data input-output by program with acknowledgment is most expediently effected with the microprocessor answering with a WAIT signal to a logic '0' READY signal from the peripheral device and executing the whole cycle of anticipatory operations, then upon appearance of a logic '1' READY signal switching to continuation of execution of computer instruction cycles. The peripheral device is usually coupled to the microprocessor either through the input-output subsystem or through the memory subsystem. In the first case the input-output device is isolated and the microprocessor must include a controller which generates INPUT and OUTPUT signals. In the second case the input-output device is compatible and the peripheral device is addressed, like a memory cell, with WRITE and READ signals. Figures 4; tables 4; references 3: 1 Russian, 2 Western in Russian translation.

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CSO: 1860/267

ELECTROSTATIC DEFLECTRONS WITH PLANE ELECTRODES

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 56, No 7, Jul 86  
(manuscript received 4 Jun 85, in final version 30 Jul 85) pp 1348-1353

[Article by L. P. Ovsyannikova and T. Ya. Fishkova, Institute of Engineering Physics imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] Four different configurations of deflectrons with plane electrodes forming a rectangular channel are considered, the simplest one being a vertical pair and a horizontal pair of solid plates. In the more intricate configurations all plates are split symmetrically into two or three segments. In still another configuration two pairs of equilateral L-plates form respectively opposite corners. The potential distribution in these deflectrons is calculated by the Fourier method, in the two-dimensional approximation of a "box" formed generally by  $4K$  electrodes (number of plate segments  $k = 1, 2, 3 \dots$ ), assuming infinitesimally narrow gaps between adjacent plate segments, with the ratio  $a/b$  of distances between vertical electrodes and between horizontal electrodes in the argument of the Fourier series coefficients. The results reveal that it is possible to compensate aberrations by introducing controllable periodic nonuniformity of the electric field, 2-segmental or 3-segmental plates being most desirable for this purpose in the case of wide-angle diverging charged-particle beams. Figures 4; references 5: 3 Russian, 2 Western (1 in Russian translation).

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CSO: 1860/301

MAGNETOTHYRISTOR NANOSECOND PULSE SHAPER WITH POWER  $> 100$  MW

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May-Jun 86  
(manuscript received 15 Apr 85) pp 129-132

[Article by V. A. Vazhdayev and I. G. Katayev, Gorkiy Polytechnical Institute]

[Abstract] Electronics development leads to increasingly higher requirements on pulsed power sources. The greatest difficulty appears during an increase of the power of short duration pulses,  $\sim 1$ -10 nanosecond, because the two requirements are contradictory. The short durations of the pulses do not make it possible to enlarge the size of the device, which would promote an increase of power. Furthermore, in a number of cases an increase of dimensions proves to be impossible because of the absence of corresponding solid-state elements. However, such a situation is established by the use of ferrite rings. A shaper is considered in which ferrite rings operate in a regime close to the maximum. The circuit diagram is presented of a shaper of nanosecond pulses based on ferrites and thyristors with a power of 130 MW at a 75 ohm load. The first part of the circuit is an ordinary magnetothyristor shaper. It contains two step-up transformers. At the output of the second transformer the voltage is  $> 200$  kV. The pulse is bell-shaped. In the second part of the circuit a pulse is formed with a shape close to square. The shaper is made from three pieces of coaxial lines, separated by relatively short pieces of ferrite.

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UDC 681.516

## SYNTHESIS OF DYNAMIC COMPENSATOR OF BASIS OF SYLVESTER'S MATRIX EQUATION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 6, Jun 86 (manuscript received 16 Oct 85) pp 20-24

[Article by Yu. I. Parayev and Ye. A. Perepelkin, Siberian Institute of Engineering Physics, Tomsk State University]

[Abstract] An object describable by the equations  $\dot{x} = Ax + Bu$ ,  $y = Cx$  (with  $n$ -dimensional state vector  $x$ ,  $m$ -dimensional control vector  $u$ ,  $l$ -dimensional measurement vector  $y$ ) is to be controlled by a dynamic compensator describable by the equations  $u = Fz + Ky$ ,  $\dot{z} = Gz + Ry$  (with  $p$ -dimensional vector  $z$ ). The problem is to select matrices  $F, K, G, R$  which will make the eigenvalues of the expanded matrix  $\Phi = \begin{bmatrix} A + KKC & KF \\ KC & G \end{bmatrix}$  of that closed system of two object equations and two control equations coincide with  $n + p$  given complex or real numbers in the left-hand half-plane symmetrically spaced with respect to the real axis. The problem is solved here and a  $p$ -dimensional ( $p = n - m$ ) dynamic compensator for the object is synthesized on the basis of Sylvester's matrix equation. A matrix  $T$  of order  $n \times (n - m)$  is introduced and a nonsingular matrix  $L = \begin{bmatrix} T & I_n \\ I_{n-m} & 0 \end{bmatrix}$  ( $I_n$  - unit matrix of order  $n$ ) is constructed, whereupon a matrix  $\tilde{\Phi} = L^{-1}\Phi L$  similar to matrix  $\Phi$  is constructed and matrix  $T$  is made to satisfy the equation  $AT - T(RCT + G) + B(KCT + F) = 0$ . The algorithm of synthesis based on solution of this equation yields a dynamic compensator without explicitly estimating the state of the object. It is demonstrated on a specific example, namely stabilization of the lateral motion of an aircraft. References 6: 5 Russian, 1 Western (in Russian translation).

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CSO: 1860/299



## STABILITY ANALYSIS OF ONE CLASS OF PULSE-PHASE AUTOMATIC FREQUENCY CONTROL SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 6, Jun 86 (manuscript received 5 Jun 85) pp 24-28

[Article by N. N. Butenina and V. S. Metrikin, Scientific Research Institute of Applied Mathematics and Cybernetics, Gorkiy State University]

[Abstract] A pulse-phase automatic frequency control system is considered which consists of a single loop containing a tunable harmonic oscillator, a phase-lead counter, and a noninductive pulse-phase detector in series. Its stability during synchronous operation is analyzed on the basis of the set of equations relating phase  $\bar{\tau}$  of a pulse to phase  $\tau$  of the preceding pulse at the counter output. A region D is defined in the space of divisors containing a stable stationary point  $\tau^*$  but no stable periodic double-phase points within the monotonic range of function  $\bar{\tau}$ . The conditions are established under which this region D can coincide with the region of stability on-the-whole of periodic motion corresponding to that stationary point  $\tau^*$ . Figures 3; references: 9 Russian.

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TELEVISION RECORDER OF TRANSIENT PROCESSES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May-Jun 86  
(manuscript received 14 Jun 85) pp 151-153

[Article by V. P. Gutanov, Institute of Heavy-Current Electronics, Siberian  
Department Academy of Science, USSR, Tomsk]

[Abstract] A recorder of transient processes in the nanosecond range of duration, based on the KTP-67 television camera and a wide-band oscillograph is described. The resolution with respect to amplitude is 10 binary digits, with respect to time is 256 readouts. The recording speed of single signals corresponds to the certificate of the oscillograph utilized. The recorder with an I2-7 oscillograph and a 'MERA-60' [roman letters] computer are used during investigation of generators of super-high frequency power pulses with a duration of 5-25 nanoseconds. After preliminary processing in a computer and calibration, the amplitude, the instability of amplitude, the duration and rise time of the recorded pulses are measured. The recorder is fulfilled according to the CAMAC (Computer Automated Measurement and Control) standard. Figures 3; references: 2 Russian.

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MILLIMETER RANGE PHASEMETER WITH ROTATABLE GRATING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May-Jun 86  
(manuscript received 5 Feb 85) pp 153-154

[Article by V. V. Kryzhanovskiy and V. P. Shestopalov, Institute of Radiophysics and Electronics, Academy of Science, USSR, Kharkov]

[Abstract] A device for shaping a reference channel during phase measurements at millimeter wavelengths, using a doppler frequency converter, is described. The system consists of a dielectric waveguide and a diffraction grating located close to the lateral face of the waveguide. The frequency is converted by rotation of the diffraction grating. Basically, fluctuations of the phasemeter readings are caused by instability of the klystron generator employed. The real drift of the phasemeter readings in 30 minutes does not exceed  $\pm 5^\circ$ , and the total error of measurement of the initial phase of electromagnetic oscillations amounts to  $\pm 8^\circ$  in the 4 millimeter wave band. Figures 1; references 6: 5 Russian, 1 Western in Russian translation.

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COMPENSATING FOR TECHNOLOGICAL ERRORS OF COAXIAL CYLINDRICAL CAPACITIVE LEVEL SENSORS ON MEASUREMENT ACCURACY

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian, No 1, Jan 86  
(manuscript received 23 Mar 85) pp 94-101

[Article by Z. Ya. Monastyskiy and A. M. Savolyuk]

[Abstract] An analysis is made of the possibility of reducing the influence of technological errors of sensors on level measurement accuracy by compensating the combined deviation of the initial capacitance. It is found that compensating for the deviations of the initial capacitance of coaxial cylindrical level sensors makes it possible to eliminate the influence of such technological errors as spread of the radial dimensions, cross-sectional ellipticity, and parallel displacement of the axes of the electrodes. Recommendations are given for the design and fabrication of capacitive level sensors. Figures 3, references: 5 Russian.

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UDC [621.315.3:538.945].014.1.013.001.24

THEORY OF CURRENT DISTRIBUTION IN MULTIWIRE SUPERCONDUCTING CONDUCTORS UNDER INFLUENCE OF INTRINSIC AND EXTERNAL MAGNETIC FIELDS

Moscow ELEKTROTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 30 May 85) pp 32-35

[Article by I. B. Peshkov, doctor of technical sciences, Professor, V. Ye. Sytnikov, candidate of technical sciences, G. G. Svalov, Doctor of technical sciences]

[Abstract] This study investigates the quantitative connection between the current distribution among the individual wires and windings in multi-wire superconducting conductors and the inductance of the wires and the value of the external magnetic field. Multiwire conductors containing an arbitrary number of windings are investigated. The currents in the windings is calculated by means of Maxwell's second equation in integral form. The intrinsic magnetic field is found to result in irregular current distribution through the cross-section of twisted multi-wire superconducting conductors. Single- and two-layer constructions are found to be best. When two layers are used, their twists should be in opposite directions, and the number of superconducting wires in the inner wire should be based on the calculated value of the current in the inner layer with critical current present in the outer layer. Figures 4, references 4: 2 Russian, 2 Western.

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SURFACE-ACOUSTIC-WAVE RESONATOR TUNABLE OVER WIDE RANGE OF NATURAL FREQUENCIES

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 56, No 7, Jul 86  
(manuscript received 11 Jun 85) pp 1396-1398

[Article by V. M. Pashkin, M. S. Sandler and B. V. Sveshnirov]

[Abstract] The feasibility of widening the frequency range of a SAW resonator by means of a reflecting interdigital converter inside the resonator cavity is examined on the basis of theoretical relations and experimental data. Theoretical calculations are based on the model of two reflectors forming a resonator cavity and an electrically controllable reflector inserted between them so that the effective length of the cavity becomes adjustable. The corresponding dispersion equation has two groups of roots, which represent respectively fixed and tunable modes. The frequency separation between tunable modes is adjustable by regulation of the reactive load, especially so when the resistances which determine losses and attenuation in matched circuits are very small. A quantitative analysis of the tuning characteristic, namely the frequency characteristic of the transmission coefficient, indicates an analogy to a Fabry-Porot resonator with equivalent reflection coefficients at the two mirrors. The results of experiments performed using three interdigital converters as reflectors with aluminum electrodes on ST-cut quartz crystals confirm the feasibility of wide tuning of such a resonator. Figures 2; references 5: 2 Russian, 3 Western.

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CSO: 1860/301

UDC 621.374.34:621.318.14

FREQUENCY-SELECTIVE LIMITATION IN PARAMAGNETIC MICROWAVE FILTERS

Moscow RADIOTEKHNIKA in Russian No 5, May 86  
(manuscript received 14 Oct 85) pp 27-28

[Article by V. G. Zaytsev]

[Abstract] Limiters are generally employed for abatement of intense noise, the frequency of which lies in the passband of a receiver. The most promising of them, frequency-selective limiters, make it possible to weaken the intense components of the input signal with a minimum effect on the remainder. Paramagnetic microwave filters are an example of such devices. The results are presented of a theoretical and experimental investigation of the frequency dependence of the working attenuation of a paramagnetic filter of bimodel construction with operating frequencies in the 5-10 GHz band. The author thanks V. M. Vladimirov for assistance in conducting the experiment and V. Ye. Zobov for helpful discussion. Figures 2; references 4: 3 Russian, 1 Western in Russian translation.

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CSO: 1860/282

UDC 621.385.632:621.391.822

STUDY OF WIDE-BAND NOISE TRANSMISSION THROUGH TRAVELLING WAVE TUBES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 13 Dec 83) pp 760-766

[Article by V. S. Grishin, A. V. Derunov, I. A. Mankin, A. A. Shakhat and  
V. G. Shkolnikov]

[Abstract] A study is made of some peculiarities of the interaction of an electron flux in a travelling wave tube with broad band noise. Primary attention is given to the influence of band width on the energy and probability characteristics of the noise signal, as well as the energy spectrum of the electrons at the output of the TWT. Computation results are compared with experimental data. Theoretical analysis of the amplification of the wide band noise signal in the TWT, based on the unsteady nonlinear theory, shows that the effectiveness of interaction of the electron flux with a complex signal is largely independent of band width and the decrease in efficiency is determined primarily by the nonlinearity of the amplitude characteristic. The energy spectrum of the electrons increases in width with an increase in signal band width. Figures 7, references 16: 14 Russian, 2 Western.

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UDC 621.397.13.029.64

# WIDE BAND MULTICOMPONENT DIFFRACTION MICROWAVE LENS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 10 Aug 84) pp 800-806

[Article by I. V. Minin and O. V. Minin]

[Abstract] Results are presented from experimental studies of the focussing and frequency properties of a multicomponent diffraction-type radio lens satisfying a list of requirements for a radio-optical system based on the needs for maximum resolution and minimum lens diameter. Results are presented from experimental studies of the radio lens suggested in the two millimeter band. A photograph of the multicomponent diffraction lens is presented. The results show that the surface of the image generated is a sphere with an accuracy of at least 2% with a center located in the middle of the rear component of the lens. The experimental studies of the lens show that it provides a field of vision of 60% with up to 160x element resolution with a distance between components of the lens of  $100\lambda$ . Figures 3, references 9: 8 Russian, 1 Western.

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EXPERIMENTAL STUDY OF WAVE GUIDE-OPTICAL READING OF SIGNALS IN SURFACE  
ACOUSTICAL WAVE DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 8 Apr 84) pp 807-814

[Article by A. F. Bessonov, L. N. Deryugin and V. A. Komotskiy]

[Abstract] An experimental study is presented of reading characteristics from the standpoint of such actual devices as delay lines, modulators and signal processing devices. The model of integral-optical readings used employed a steady reference diffraction grating in an optical wave guide, based on a sound guide of lithium niobate with a diffusion optical wave guide. The experimental study of the model produces amplitude transfer characteristics with respect to the first three harmonics which agree well with the calculated values. The transfer coefficients and dynamic range are determined for the model. Nonlinear distortion and the dynamic range are analyzed in wave guide-optical reading circuits with a reference grating. The data obtained can be used in developing delay lines with optical readout, acoustico-optical modulators and sensors for physical quantities based on wave guide-optical systems. Figures 4, references 11: 7 Russian, 4 Western.

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DISPERSION PROPERTIES OF CIRCULAR WAVE GUIDE 'STRONGLY EXCITED' BY  
DIELECTRIC ROD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 4, Apr 86  
(manuscript received 21 Jan 85) pp 815-817

[Article by G. P. Veselov, S. G. Semenov and V. A. Blagoveshchenskiy]

[Abstract] A previous work obtained diagrams of critical HE conditions which can be used to determine the ratio of dimensions of a wave guide and rod and the frequency band of existence of a complex wave. This article presents additional information on dispersion properties of a circular wave guide with dielectric rod at high values of  $\epsilon$ . It is shown that combining the diagrams of critical HE conditions for low and high types of waves is related to the appearance on the dispersion curves of a degeneration point of multiplicity 3. Figures 2, references: 8 Russian.

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DIELECTRIC STRIP WAVEGUIDE GATE FOR SHORT-WAVE PORTION OF MILLIMETER BAND

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 19 Jun 85) pp 59-61

[Article by L. N. Vershinina and M. P. Parkhomenko]

[Abstract] A miniature gate device that operates on the basis of the Faradya effect in the two-millimeter band in a longitudinally magnetized hexaferrite is developed and investigated. The gate employs a variable attenuator made up of a magnetized hexaferrite plate, a dichroic polarized plate, and quarter-wave matching plates, with a half-wave leucosapphire plate between the hexaferrite and the polarizing plate. The operation of the device is described, and the forward and reverse losses are measured by the substitution method. The direct losses comprised 1.6-2.6 dB, and the reverse losses exceeded 20 dB over the entire range. Figures 2, references: 9 Russian.

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SYNTHESIS OF MICROWAVE BEAM ENERGY TRANSMISSION PATH

Moscow RADIOTEKHNIKA in Russian, No 2, Feb 86  
(manuscript received 18 Jun 85, after revision) pp 69-72

[Article by V. A. Banke, S. K. Lesota and A. V. Rachnikov]

[Abstract] The amplitude distribution of the electrical field strength over the aperture of the transmitting antenna of a microwave beam energy transmission circuit is optimized in accordance with the required maximum power density on the aperture of the transmitting antenna and the power density in the beam close to the ground. Nonlinear multiparameter optimization is used to obtain discrete ten-step amplitude distributions that can be used to create an energy transmission path with characteristics suitable for orbiting solar power plants. The behavior of the efficiency, transmitted power, and radii of the transmitting and receiving antennas are investigated as a function of the maximum power density on the aperture of the transmitting antenna, the power density in the beam close to the ground, and the power density level of the lateral radiation beyond the edges of the receiving antenna. Figures 4, references 9: 5 Russian, 4 Western.

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CLOSED-LOOP AUTOMATIC SPEED REGULATION OF INDUCTION MOTOR WITH FREQUENCY-CONTROLLED RESISTANCE IN ROTOR CIRCUIT

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 6, Jun 86 (manuscript received, after revision, 11 Feb 86)

[Article by Zakir Alikram ogly Gasanov, candidate of technical sciences,  
junior scientific, associate Azerbaydzhan Petrochemical Institute]

[Abstract] Static and dynamic characteristics of a wound induction motor with closed-loop automatic speed regulation by frequency control of the equivalent rotor circuit resistance are calculated, such a control loop including an inverter and a tachometer generator as well as a summing amplifier and a limiter. The running characteristics are found to be those required of an excavator motor. The starting characteristics and response to load transients are found to be better than those of induction motors in cascade. Closed-loop automatic control with counter-emf feedback adds to stiffness and stability against mechanical oscillations. Quantitative analysis is based on experimental data pertaining to automatic control of an AK-51/4 hoist motor rated 2.8 kW at 1370 rpm. Figures 3; references: 4 Russian.

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ECONOMICAL THYRISTOR GENERATOR OF LARGE-AMPLITUDE CURRENT PULSES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 6, Jun 86 (manuscript received 23 Mar 84) pp 122-124

[Article by Vladimir Aleksandrovich Kuznetsov, graduate student, and Viktor Yevgenyevich Gromov, candidate of physico-mathematical sciences, assistant professor Siberian Institute of Metallurgy]

[Abstract] A generator of large-amplitude short-duration current pulses for pressure treatment and plastic deformation of metals has been developed which is both power efficient and economical. Its main feature, supplementing a charger with a switch across a storing capacitor and a charger-switch (n parallel thyristors with n equalizing chokes) in series with the load across it, is a recharger-switch (m parallel thyristors with m equalizing chokes) in series with a current-limiting choke and a saturable-core choke also across the storing capacitor. While the latter is recharged, a delay circuit in series with the main charger either blocks its voltage (when a thyristor is used for delay and it is closed) or reduces the current from it to far below the recharge current (when an inductance is used for delay) and thus minimizes the power drawn from the supply line during recharge. A current transformer inserted between the charger-switch and the recharger-switch, with an inverter, a holding device, and a pulse amplifier-shaper in the secondary, synchronizes opening of the recharger-switch with the main current pulse and forms control pulses for the recharger-switch thyristors. The generator can deliver current pulses of up to 14 kA amplitude and only 60-100  $\mu$ s duration at a repetition rate up to 2 kHz. The unit improved the performance of wire-drawing equipment for low-carbon steel wire. Figures 3; references 4: 3 Russian, 1 Western.

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CSO: 1860/302

STATE OF ART AND DEVELOPMENT TRENDS IN TRANSFORMER MANUFACTURE

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 86, pp 2-6

[Article by I. D. Voyevodin, candidate of technical sciences, V. K. Matviyenko, engineer and I. Yu. Meleshko, engineer]

[Abstract] While the volume of transformer production has remained steady during the 1981-85 period, after a rise during the 1971-80 period and before another rise projected for the 1986-90 period, the consumption of transformer steel has actually decreased and will only slightly increase because of a continuously decreasing kg/kVA ratio. The latest achievement in transformers for electric power transmission are 750 kV - 3x320 MVA units now tested in a special cage built for this purpose at the Transformer Manufacturing Plant in Togliatti. Developments leading to this state of the art include better steels and better insulation materials. A contributing factor is the use of computer-aided design systems, already available for general-purpose transformers and dry instrument transformers. Meanwhile, more attention should be paid to transformers in the 6-10/0.4 kV class with power ratings up to 1000 kVA for railroad transportation and petrochemical rigs. For substations and electric power transmission, development of transformers and autotransformers in the 1150 kV class with power ratings up to 3x2000 MVA is now underway. Operation at superhigh voltages up to 1800 kV is expected to be feasible by the year 2000. Meanwhile, current demand will necessitate increasing the overall transformer production by 35% by the year 1990. The groundwork for attainment of these goals is being laid during the 12th Five-Year Plan period by design and manufacturing engineering and research in all relevant areas including production management. Figures 3.

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## OPTOELECTRONIC DIRECT-CURRENT TRANSFORMER

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 86  
(manuscript received 8 Aug 85) pp 6-8

[Article by V. B. Arkhangelskiy, candidate of technical sciences,  
V. P. Zubkov (deceased), candidate of technical sciences, T. P. Kazakova,  
engineer and T. G. Paley, engineer, Scientific Research Institute of Direct  
Current]

[Abstract] Measurement of large direct currents through an optoelectronic d.c. instrument transformer on the basis of Faraday's magnetooptic effect with linearly polarized light is considered, improvements being proposed which will make the current readings independent of the instability of many light source, transformer, and photoreceiver parameters. Amplitude modulation of the light intensity, most easily realized in lightguides but not allowing discrimination between current signals and instability signals, is replaced with wavelength modulation allowing such a discrimination. This requires sending light at two different wavelengths from two separate sources through the Faraday cell so that the current can be determined from the difference between the two angles through which the two polarization planes respectively rotate. The optics include besides two light sources and a lightguide also a mixer, a focusing lens which forms a parallel light beam, a polarizer before and an analyzer behind the cell. The light sources are controlled by a generator of square voltage pulses. The azimuth of a polarization plane changes by an angle proportional to the measured current and to the Verdet constant, the latter being different at different wavelengths. The analyzer is followed by another lens, which converts azimuth changes into intensity changes and transmits two light beams over separate lightguides to separate photoreceivers for conversion into voltage signals. The electronics include besides the generator of square voltage pulses also a reference-voltage generator, two amplifiers, two differential amplifiers, two low-pass filters, two synchronous detectors, a summator, a subtractor, a selective amplifier, a controlled attenuator, and a plain attenuator. The principle of operation of this optical direct-current transducer has been checked out experimentally. Figures 1; references: 2 Russian.

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CSO: 1860/294

MULTITARGET OPTIMIZATION OF PROMISING ELECTRIC POWER SYSTEM STRUCTURE BASED ON COMPREHENSIVE EFFECTIVENESS INDICATORS OF POWER PLANTS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 5, May 86, pp 3-6

[Article by V. R. Okorokov, doctor of technical sciences, professor and S. G. Artemenko, engineer, Leningrad Polytechnic Institute imeni M. I. Kalinin]

[Abstract] An algorithm has been devised for multitarget optimization of a promising electric power system structure, by significance ranking and weighting of comprehensive power plant effectiveness indicators on the basis of expert opinion. The choice is typically between steam electric power generated by natural gas or coal, nuclear power, hydroelectric power, pumped-storage hydroelectric power, and geothermal power. The choice is made on the basis of maximum reliability, minimum capital investment, minimum annual operating cost, widest range of regulation, minimum operating labor, minimum consumption of scarce energy sources, shortest construction time and readiness for operation, and minimum detrimental impact on the environment. All these targets are referred to a requirement for 10,000 MW additional power to become available at a given nominal target date. Calculations are made by the method of linear programming and are tied in with the linear model of an electric power system. Figures 1; tables 4; references: 4 Russian.

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CSO: 1860/281

UDC 621.311:681.3.06

DESIGN OF UNIFIED SYSTEM AUTOMATICALLY REGISTERING, MONITORING, AND  
MANAGING ENERGY CONSUMPTION

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 5,  
May 86, pp 12-19

[Article by V. S. Kakhanovich, candidate of technical sciences, assistant  
professor, Belorussian Polytechnic Institute]

[Abstract] A unified system automatically registering, monitoring, and  
managing energy consumption is designed for beyond the 1986-90 period, cover-  
ing all levels of energy consumption from individual users through industrial  
associations and territorial administrations to regional and nationwide power  
systems. The operation of this system will depend on accuracy, speed, and  
reliability of data acquisition, the key elements here being kilowattmeters  
and kWh meters, and data, the data processing by transducers and counters  
for a large high-speed computer adequate for functioning as the control  
center. Figures 2; tables 1; references: 20 Russian.

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## EXTENDING SCOPE OF TIS-2E STANDARD TELE-INFORMATION SYSTEM

Moscow ENERGETIK in Russian No 4, Apr 86, pp 16-17

[Article by V. D. Shoykhet, engineer and N. P. Novichkov, engineer,  
Voronezh Regional Administration of Power System Management]

[Abstract] The existing TIS-2E system installed in 1984 in the Kalach electrical power network for automatic dispatcher control of peak-power electric power plants consists of an 'Elektronika-60' microcomputer, an automatic reclosure control, an interface to remote controls, and two displays one of which facilitates dispatcher-computer dialog while the other informs about perturbation or switchover events. The functions of this system include input and processing of data from substations of the regional power plant and four regional peak-load power plants, recording on the dialog display date and time of events, measurement lists, positions of switches, 32 graphic substation control charts in color, tables of preset but adjustable operational measurement limits, remote readings and signals, also feeding tables of operational remote readings for printout and storing the data array in the direct-access memory. An outstanding feature of the Kalach automatic dispatcher control is well organized 2-stage data acquisition and transmission, first stage from substation to regional dispatcher and second stage with relaying equipment from regional power plant to peak-load power plants. Only one of the four subregions is telemechanized so far, the three others still need to be. A computer complex consisting of one SM-1420 mini-computer and two SM-1800 will also be needed. This complex should be tied into the Voronezh Power System intercomputer data exchange system using TELE-Yes 'Unified System' hardware and software, to facilitate solution of electrical engineering and production management as well as operational information handling problems.

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UDC 621.314.632.004.1.004.67

IMPROVEMENT OF OPERATION AND REPAIR OF SEMICONDUCTOR RECTIFIERS FOR TRACTION SUBSTATIONS

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 2, Feb 86, pp 10-13

[Article by Yu. V. Sobolev, candidate of technical sciences, Urals Department, All-Union Scientific Research Institute of Railroad Transport, and Ye. G. Bobrov, candidate of technical sciences, Dnepropetrovsk Institute of Railroad Transport Engineers]

[Abstract] The authors' organizations have undertaken a system of studies intended to determine the causes, nature and characteristics of semiconductor rectifier failures considering the specifics of operation of traction substations on main rail lines, and have developed methods and equipment for diagnosis and generation of recommendations for increasing reliability, improving design, operating methods and maintenance of the rectifiers. The developments have been tested and put in use in the Soviet rail system. The studies indicate that rod-type power diodes with soldered contacts, used to make semiconductor rectifiers for traction substations, have short thermal cycle life. Rectifier reliability can be improved by periodically monitoring the internal heat resistance of the diodes and using the results to reject failing diodes, and also by achieving optimal load conditions to decrease aging of the diodes. Thermal cycle resistant diodes with pressure contacts should be used in converters where diodes are found to age rapidly.

References: 6 Russian.

6508/12955

CSO: 1860/255

UDC 621.311.4.014.1.001.2

DETERMINING ECONOMICALLY EXPEDIENT CURRENT DENSITY FOR 6-10 KV CABLE LINES

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 2, Feb 86, pp 30-32

[Article by O. G. Leibman, engineer, Minsk Division, All-Union State Institute for Design of Enterprises for Construction Materials Industry]

[Abstract] It is suggested that the economically expedient current density in 6-10 kV cable lines be determined as a function of the cost of electric power and the number of hours of connection of electrical loads. The problem is solved based on the annual cost and corresponding minimum cost of the economical current density. It is suggested that the maximum line current be replaced by its average value, the maximum lost time by the number of hours per year of connection of electrical loads when calculating annual costs. The decrease in annual costs resulting from this change in calculation method is estimated at 3 rubles per A · km, representing a significant savings on the nationwide scale. References: 4 Russian.

6508/12955

CSO: 1860/255

UDC 621.317.799:621.9.022

INSTRUMENT FOR TESTING PORTABLE POWER-USING DEVICES

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 2, Feb 86, pp 20-21

[Article by V. I. Poluektov, engineer, Tolyatti Polytechnical Institute]

[Abstract] The author has developed a device called the SPEI-1 with a set of typical sockets used to power portable electric tools and lamps to allow periodic testing of these potentially dangerous devices. The SPEI-2 instrument is an improved version of the previous device with the capability added of testing the test instrument itself before it is used to test portable electric equipment. The SPEI-2 is more universal, having more different types of sockets than the previous device, can perform a full program of electrical testing and is easy to use. Figure 1.

6508/12955

CSO: 1860/255

## EFFECT OF SMALL-AMPLITUDE ALTERNATING VOLTAGE ON UNIPOLAR CORONA DISCHARGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 2, Mar-Apr 86 (manuscript received, after revision, 5 Jun 85) pp 103-110

[Article by B. G. Pevchev, Moscow]

[Abstract] Continuous corona discharge of positive polarity is considered, particularly the effect of a low rather than high alternating voltage superposed on the direct voltage. The analysis is based on the equation of a corona discharge current with compensation of the capacitive component in the external circuit, in accordance with the Shockley-Ramo relation, this equation being reducible to a linear nonhomogeneous Fredholm integral equation of the second kind. Across the gap with discharge are applied first a square ionizing voltage pulse and then a sinusoidal voltage of small amplitude. The latter is found to cause oscillations of the discharge current. The amplitude of the compensated discharge current increases as the frequency of the applied voltage is increased, but only up to a limit which is higher for a discharge with a larger direct-current component. Beyond this limit discharge will be quenched for an increasing part of the oscillation period. Figures 4; references 6: 5 Russian, 1 Western.

2415/12955  
CSO: 1860/293



UDC 621.315

POSSIBLE WAYS TO INCREASE RELIABILITY OF 1150 kV OVERHEAD ELECTRIC POWER  
TRANSMISSION LINES

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 2,  
Mar-Apr 86 (manuscript received 20 Jun 85) pp 35-42

[Article by A. S. Artemyev, A. N. Novikova, S. N. Rozhanskaya, N. N.  
Tikhodeyev and S. S. Shur, Leningrad]

[Abstract] Reliability of 1150 kV overhead electric power transmission lines such as the Siberia-Kazakhstan-Ural line now being built is essential to viability of the Unified USSR Power System, especially because their capacity is comparable with that of the largest electric power plants. Their reliability is predicted on the basis of experience in design and performance of existing 750 kV overhead transmission lines. A key problem in reliability assurance is making automatic single-phase reclosure with use of reactors unnecessary by preventing removable faults. This can be achieved by redesign of the protection system into the range of negative angles and by use of "embracing gantry" support structures with longer chains of better insulators and with the middle phase in a lower position. This will also reduce shutdown time, inasmuch as insulators are the principal maintenance and repair item. Figures 3; tables 1; references 10: 8 Russian, 2 Western.

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CSO: 1860/293

UDC 621.315.1.003.621.311

PROCEDURE FOR EVALUATING SYSTEM EFFECTIVENESS OF 330-750 kV OVERHEAD  
TRANSMISSION LINES WITH STEPPED-UP NOMINAL POWER RATING

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 2,  
Mar-Apr 86 (manuscript received 8 Apr 85) pp 49-55

[Article by A. N. Zeyliger, N. A. Kolganova, P. A. Malkin and A. P. Gusev,  
Leningrad and Novosibirsk]

[Abstract] Stepping up the nominal power rating of transmission lines by a factor of 1.25-2 should result in correspondingly higher stability limit and less heating with better voltage characteristics and lower energy losses. The magnitude of this overall system effect depends on the mode of operation of such a transmission line within the power system. A procedure for evaluating this effect is proposed, applicable specifically to 330-750 kV overhead transmission lines operating in a Unified Power System with appropriate transverse and longitudinal capacitive compensation for power factor correction. Both performance effectiveness and cost effectiveness are considered in the evaluation, on the basis normal continuous load conditions as well as anomalous load conditions usually momentary but nevertheless governing the design. As criterion for installed compensating capacity serves either the maximum permissible voltage at the receiver end or the maximum available reactive power at the sender end, when the transmission line serves for power distribution. When it serves as intersystem tie, then only cost effectiveness of longitudinal compensation needs to be considered versus replacement by a new line. This procedure establishes ranges of effectiveness, evidently dependent on the design and the mode of operation, as well as scale factors for application of overhead transmission lines with stepped-up nominal power rating. Figures 4; tables 1; references: 4 Russian.

2415/12955  
CSO: 1860/293

UDC 621.396.67

CALCULATION OF SHEATH-GROUND CIRCUIT PARAMETERS OF UNDERGROUND CABLE LINE  
TAKING INTO ACCOUNT TRANSVERSE GROUND CURRENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian  
No 2, Mar-Apr 86 (manuscript received 13 Jun 85) pp 82-90

[Article by N. I. Gumerova, M. V. Kostenko, N. Ye. Marchenko, V. V. Potapov  
and A. A. Smirnov, Leningrad]

[Abstract] The sheath-ground circuit parameters per 1 km length are determined for an underground cable line with ground insulation of the sheath. Calculations are based on the model of an infinitely long straight cylindrical conductor which carries a sinusoidal alternating current and has been embedded horizontally in the ground at some depth but insulated from it with a dielectric layer of uniform thickness. Into account are taken the ground-air interface above the cable and an exponential attenuation of the current in the sheath-ground circuit along the cable. These calculations, made according to two-dimensional field theory and by the method of successive approximations, yielded the transverse electrical conductivity of the ground and of the insulation, the frequency dependence of their moduli, and the frequency dependence of the characteristic impedance of the sheath-ground circuit with various insulation materials, each having a different electrical resistivity, and with the insulation thickness varied from 0.01 mm to 10 mm. The results indicate a strong effect of transverse ground currents, especially significant during transients. Figures 4; references 15: 12 Russian, 3 Western (1 in Russian translation).

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CS0: 1860/293

CALCULATION OF ELECTROMAGNETIC FORCES ACTING ON SHIELD CONDUCTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian  
No 2, Mar-Apr 86 (manuscript received 3 Dec 84) pp 96-102

[Article by G. N. Tsitsikyan, V. Ye. Shpitsberg and A. Ya. Lapovok,  
Leningrad]

[Abstract] Electromagnetic forces acting on coaxial tubular conductors of a circular cylindrical nonmagnetic shield after turn-on of a field source are calculated by the method of Laplace transformation and according to the principle of superposition, when the number of current lines outside the shield is large. The method is general and does not require a simple analytical description of transient responses. With the use of appropriate Laplace transform pairs for current and for induced magnetic field, forces can be readily determined in specific cases such as current pulse consisting of several exponentially decaying components or a sinusoidal current signal. Figures 2; tables 1; references 10: 7 Russian, 3 Western (1 in Russian translation).

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CSO: 1860/293

UDC 621.316.37-213.1:621.3.048

EFFECT OF FORM OF VOLTAGE PULSES ON ELECTRIC STRENGTH OF ROD-PLANE AIR GAP  
WITH DECREASED PRESSURE OF ATMOSPHERE

Dushanbe IZVESTIYA AKADEMII NAUK TADZHIKSKOY SSR: OTDELENIYE FIZIKO-  
MATEMATICHESKIKH, KHEMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 1,  
Jan-Mar 86, pp 57-61

[Article by G. N. Aleksandrov, R. S. Burkhanov, S. I. Vyalov and S. M.  
Yulchiyev, Leningrad Polytechnical Scientific Research Institute imeni  
M. I. Kalinin and Tadzhik Scientific Research Department of Power Engineering]

[Abstract] The results are presented of investigations more thorough than those previously made of the electric strength of an air gap between a 5-meter rod with a radius of curvature of the tip of 15 mm and a metal grounded plane  $8 \times 8 \text{ m}^2$  with a change of the duration of pulse fronts over a wide range -- from 10 to 1500  $\mu\text{s}$  and an interelectrode separation up to 5 m. In spite of the fact that the rod-plane interval does not have analogs in electrotechnical devices, it was selected as an object of experiments because under normal air pressure it possesses a most clearly defined dependence of 50% of the discharge voltages on the form of the voltage pulses. The investigations are conducted at a height of 3400 meters above sea level with an average air pressure of 68 kPa. Figures 4; references 8: 7 Russian, 1 Western.

6415/12955

CSO: 1860/309

CALCULATION OF ELECTRODYNAMIC FORCES IN PLANE CIRCUITS WITH ARBITRARY CURRENT DISTRIBUTION

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 1, Jan 86  
(manuscript received 12 Apr 85) pp 37-41

[Article by Yu. M. Vasetkiy and A. I. Zamidra]

[Abstract] A method developed previously by the author for calculating the electrodynamic forces occurring in windings for creating a magnetic field for the case of uniform current density distribution is extended to the case of arbitrary current density distribution. The cross-section of the conductor is assumed to be smaller than the dimensions of the circuit itself. Analytical expressions are derived for the small parameter that takes into account the cross-section and current density distribution. A conductor with a round cross-section is examined as an example of nonuniform current distribution. Figures 1, tables 1, references: 4 Russian.

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CSO: 1860/219

UDC 537.2:621.3

ELECTRICAL FIELDS AND CHARACTERISTICS OF SLIGHTLY CONDUCTING PLATE WITH ROUND HOLE

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian, No 1, Jan 86  
(manuscript received 12 Mar 85) pp 41-44

[Article by L. V. Gorodzha and S. I. Strilko]

[Abstract] The current density distribution and electrical field strength in the vicinity of a hole in a slightly conducting plate with conductance anisotropy due to the Hall effect is investigated. A relationship is established between the integral resistance of the electrode system and the conductivity of the plate material that can be used to find the latter by measuring the former. This makes the method useful in developing sensors for monitoring the conductivity of materials in magnetic fields. Figures 1, references: 2 Russian.

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CSO: 1860/219

UDC 535.338

SHAPE OF RADIOOPTICAL DOUBLE-RESONANCE LINE IN CASE OF NONLINEAR OPTICAL INDICATION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 4, Apr 86 (manuscript received, after revision, 14 Dec 84) pp 413-418

[Article by L. A. Budkin, M. N. Penenkov, A. I. Pikhteleev and V. L. Mikhaylovskiy]

[Abstract] For emission from a gas laser with an active medium of 3-level atoms and with a nonlinear intracavity absorption cell, a microwave field is analyzed, of particular concern being double radiooptical resonance. Its characteristics are determined from the system of equations for the density matrix, including coherence at the nonresonant optical transition but disregarding the frequency pull of optical radiation. The condition for equal effective amplification in the two media and for linear losses is established on the basis of the conventional equations for laser power and frequency, this condition in turn yielding an expression for the effective gain at exact radiooptical resonance or zero frequency mismatch between laser and resonator. The most important feature of this expression is that it admits the possibility of hysteresis under either stiff or soft excitation. For the latter case is calculated the dependence of the effective gain on the laser output power and of the laser output power on the frequency mismatch. With the active medium saturating slower than the absorber, steady emission is attainable at two power levels: at a high power level with amplification saturated and absorption near zero when the rate of optical pumping at the electric-dipole transition 1-3 equals the rate of relaxation at the magnetic-dipole transition 1-2, at a low power level with amplification saturated and absorption saturated. The radiooptical double-resonance line is plotted and its amplitude calculated on the basis of a numerical solution, an analytical solution of the problem not being feasible in this case. Figures 4; references 7: 6 Russian, 1 Western.

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CSO: 1860/280



## RESOLVING POWER OF THERMAL TELEVISION CAMERA TUBES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 5, May 86  
(manuscript received 21 Feb 84) pp 1047-1049

[Article by G. F. Semenov and A. P. Khalaim]

[Abstract] The resolving power of thermal television tubes used for visualization of the self-radiation of bodies found under ordinary conditions (at room temperature) is evaluated. Unlike tubes with an internal photoelectric effect, these tubes do not have fundamental limitations on their wavelength. The principal drawback of these tubes is their small resolving power, combined with spreading of the temperature relief as the result of the large thermal conductivity of the target. Ordinarily, experimental and theoretical determinations of resolving power are limited by the determination of space-frequency characteristics which represent the dependence of the output signal (in relative magnitudes) on the number of television lines imaged on the target (or per unit of the target length). It is shown that such an approach, justified in the case of tubes with an internal photoelectric effect, does not give reliable information concerning the ability to register small-sized details in thermal tubes. However, in order to determine the space-frequency characteristics, it is sufficient to solve the problem of temperature distribution and this is done. Figures 1; references 5: 3 Russian, 2 Western.

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CSO: 1860/277

UDC 778.38:621.385.832.8

HOLOGRAPHIC OPTICS FOR PROJECTING TELEVISION IMAGE ON LARGE SCREEN

Moscow TEKHNIIKA KINO I TELEVIDENIYA in Russian No 5, May 86, pp 37-38

[Article by I. A. Mikhaylov]

[Abstract] Holographic optics are considered for projecting a television image on a large screen and thus with large magnification. The projection is formed by a quantoscope with the entrance pupil at infinity and the exit pupil in the back focal plane of the holographic element. Primary coma and astigmatism in the aperture stop can be simultaneously compensated by spherical aberration  $S = -F^{-3}$  ( $S$ - coefficient of spherical aberration,  $F$ - focal length of holographic element). The practical feasibility has been demonstrated experimentally with a compound holographic element consisting of two contiguous holograms on bichromated gelatin, one hologram a diffraction grating recorded by two collimated beams and one hologram an extra-axial lens with spherical aberration in its diverging front induced by a concave lens. With a diffraction efficiency of 60-70%, such a system was found to ensure a resolution of 600 lines. Figures 2; references: 5 Russian.

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CSO: 1860/291

## OPTICAL REALIZATION OF REAL-TIME SCALE-INVARIANT TRANSFORM

Novosibirsk AVTOMETRIYA in Russian No 1, Jan-Feb 86  
(manuscript received 5 Oct 83) pp 82-86

[Article by I. I. Mokhun and S. N. Roslyakov, Chernovtsy]

[Abstract] Known coherent optical information processing systems invariant with respect to scale changes in the input data generally employ a Mellin transform, which in turn necessitates a rewrite operation on the transformed image, thus degrading the time performance. A scale-invariant system that eliminates the rewrite process can be designed with several stages, which incorporate complex, aspherical optical elements. Such linear multistage systems are difficult to analyze, since the output field is described by multidimensional integrals. If the elements of the optical stages impart only a continuous phase modulation, the design algorithm can be simplified substantially. This approach is applied to the one-dimensional case using Fourier and Mellin-like transforms. The theoretically demonstrated capability of constructing such scale-invariant systems having an information processing time limited only by the light propagation time through the system was checked experimentally with computer generated holograms with a maximum spatial frequency of the holographic elements of no more than 30 lines/mm. The test patterns were three slots of different widths with a maximum scale difference of 1:1.6. Photographs of their Fourier spectra are shown along with the position of seven spectral orders for both the initial and transformed orders; the same before and after localization of the spectral orders can be clearly seen from the photographs. Figures 4; references 7: 3 Russian, 1 Western, 3 Western in Russian translation.

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RANDOM SIGNAL TRANSMISSION THROUGH ASTIGMATIC OPTICAL SYSTEM

Novosibirsk AVTOMETRIYA in Russian No 1, Jan-Feb 86  
(manuscript received 4 Mar 85) pp 86-87

[Article by I. A. Vodovатов and S. A. Rogov, Leningrad]

[Abstract] An astigmatic optical system with unity magnification is subject to optical noise when used as the input system for coherent optical information processing. This paper is a mathematical analysis of the impact of the noise component on the output of such a system in which the input signal experiences a Fourier transformation along one of its coordinates and the image is generated from the other coordinate. It is assumed that the correlation range of the input signal is much less than the entrance aperture of the system. The random process at the system output is shown to be non-steady-state, though with a sufficiently small correlation function width for the input signal, this noise can be considered to be steady-state in a certain range. The analytical expressions derived for the correlation function dispersion and average value of the random output signal can be used to calculate the noise and dynamic range of astigmatic optical information processing systems. No sample calculations or experimental confirmation are adduced. Figures 1; references 3: 2 Russian, 1 Western in Russian translation.

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## MATRIX METHODS OF DESCRIBING OPERATION OF OPTICAL INSTRUMENTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian, Vol 29, No 6, Jun 86 (manuscript received 9 Apr 85) pp 59-66

[Article by A. V. Demin and I. V. Petrov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A universal matrix method of describing in a Cartesian system of coordinates the action of mirrors and lenses is proposed, inclusion of the Sinclair matrix for centered lens sets being more expedient than construction of a new special matrix. Inasmuch as the position of an optical instrument in space is uniquely defined by the position of its optical axis, the problem reduces to determining the position of a ray as it passes through a complex optical system. The problem is formulated in a three-dimensional system of coordinates and is solved by using the vector-column of direction cosines for the optical axis, a matrix-column for locating the ray relative to the optical axis in a plane, then an equivalent-mirror matrix describing the action of a mirror set and the Sinclair matrix describing the action of a centered lens set. The resultant partitioned matrix describing the action of the optical system as a whole can be represented as a product of component matrices, the unit matrix replacing the mirror matrix when passage of the ray does not change the position of the optical axis and replacing the Sinclair matrix when an afocal mirror set changes only the position of the optical axis but not the position of the ray relative to it. Describing the deflection of a ray from a two-dimensional space (plane of propagation) into a three-dimensional one requires use of the rotation matrix. The problem simplifies greatly when the optical system is located in one medium with a unity refractive index, considering that the Sinclair matrix applies to paraxial rays. The principle and algorithm of such a description are demonstrated on a periscope with X 4 angle magnification consisting of a confocal objective-ocular set and a parallel pair of two 45° mirrors. Figures 2; references 5: 4 Russian, 1 Western in Russian translation.

2415/12955

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## ADJUSTMENT OF OPTICAL SYSTEM WITH TWO ROTATABLE MIRRORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian, Vol 29, No 6, Jun 86 (manuscript received 23 May 85) pp 72-75

[Article by N. N. Messing and V. Ye. Potepun, Leningrad]

[Abstract] An optical system cannot always be adjusted by rotation of two mirrors till their normals are in such positions relative to one another that each exiting optical ray follows the required direction. Here the problem is solved for a special case, namely deflection of a single ray in the given direction by its successive reflection by two plane mirrors rotatable without constraints about respective axes fixed in space. The problem is to determine the angles through which these mirrors must be rotated for proper orientation of the exiting ray. Trivial situations without solution are avoided by assuming that each mirror rotates about an axis not normal to it. The problem is formulated as one of geometrical optics, with rotation of a mirror and action of a mirror on the ray expressed in quaternion form reducible to vector relations. The resulting nonlinear exact vector equation in two angles of rotation is replaced with an approximate linear vector equation in two incremental angles. Solution of this equation is facilitated by resolving it into two scalar equations along separate axes. This method of solution is demonstrated on an optical system for viewing a star. References 4: 3 Russian, 1 Western.

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CSO: 1860/299

## INTERFEROMETRIC RECORDING OF INFRARED IMAGES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian,  
Vol 29, No 5, May 86 (manuscript received, after revision, 10 Jul 85)  
pp 97-98

[Article by R. R. Vildanov, A. T. Mirzayev and A. N. Yakubov]

[Abstract] Recording of infrared images by the method of intensity interferometry is subject to contradictory constraints on the radiation statistics. Using the correlation of intensity fluctuations for recording the correlation function of radiation from an object in the field of highly degenerate laser illumination is possible without full second-order coherence and with any statistics of that radiation including, for instance, the presence of several space modes. A method of producing two space modes is proposed, namely with light from one laser with phase modulation of the reference light beam. This was done experimentally with equipment which included a laser in a cermet tube with transverse pumping at the  $\lambda = 10.6 \mu\text{m}$  wavelength and a Mach-Zender interferometer, the latter carrying a transparency as object in one arm and a diaphragm simulating a reference point source in the other. Beats were produced by phase modulation of the reference light beam by a mirror in a piezoceramic frame, the latter being excited by a noise signal with a 5 kHz wide frequency spectrum. The resultant light beam was split into two by a semiopaque mirror, one of them being sent to a stationary photoreceiver and one being sent to a photoreceiver which was scanning a plane parallel to the object plane. The output signals from each photoreceiver were amplified in separate band amplifiers and then multiplied by each other in an analog multiplier, their product was passed through an integrator with a time constant of 0.2 s, and the correlational output signal was decoded in an analog-to-digital converter for subsequent computer-aided reconstruction of images by means of fast Fourier transformation. Figures 2; references 3: 2 Russian, 1 Western.

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INSTALLATION FOR POWER CALIBRATION OF RECEIVING DEVICE FOR OPTICAL RADIATION,  
WITH A CLEAR APERTURE UP TO 450 mm

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May-Jun 86  
(manuscript received 18 Apr 85) p 245

[Article by N. K. Kosenko, L. I. Martyukhnia, N. I. Pivovar, I. A. Popov,  
A. S. Sakyan, A. N. Starchenko and O. K. Filippov, State Optical Institute,  
Leningrad]

[Abstract] The installation described is used to determine the photometric characteristics of devices for receiving weak laser radiation scattered in the atmosphere or reflected from the surface. The measuring circuit of the installation is constructed on the principle of a standard radio-meter. (The optical circuit is illustrated.) The series-produced devices used as source of radiation and their characteristics are listed. Their circuits are changed so that, with the aid of a grating located within the resonator, radiation can be changed to  $\sim 70$  lines in the 9 and 10 micrometer region. In order to increase the precision of measurements so as to take into account of the instability of the power (energy) of the lasers, part of the radiation is detached to a block for photodetector comparison. Technical data on the installation as a whole are presented. The precision of measurements stated is confirmed by a State Standard Certificate obtained on the installation. Figures 1.

6415/12955

CSO: 1860/307



SWITCHING MECHANISM IN HETEROSTRUCTURES WITH THIN DIELECTRIC LAYER

Moscow MIKROELEKTRONIKA in Russian Vol 15, No 4, Jul-Aug 86  
(manuscript received 5 May 85) pp 314-317

[Article by A. U. Kruchinin, Ye. Ye. Malitskiy, Ye. I. Pak and V. V. Kharin]

[Abstract] A study of Si-SiO<sub>2</sub>-Cu<sub>x</sub>S heterostructures for energy-independent memory devices based on switching from high-resistance to low-resistance state was made, with the Cu<sub>x</sub>S layer acting as anode from which Cu passed into the dielectric during switch-on and into which it returned during switch-off. A layer of p<sup>+</sup>-Si or n<sup>+</sup>-Si (charge carrier concentration p,n= 10<sup>20</sup>-10<sup>21</sup> cm<sup>-3</sup>) was produced on a p-Si substrate (electrical resistivity  $\rho$  7.7 ohm·cm) and on it was grown a 0.2  $\mu$ m thick SiO<sub>2</sub> film in which holes 3.5  $\mu$ m in diameter were then etched out. On a 9 nm thick tunneling dielectric (SiO<sub>2</sub>) layer grown in the windows was deposited a 0.1  $\mu$ m thick Cu film which, with sulfur vapor at a temperature of 500°C supplied under low pressure, formed Cu<sub>x</sub>S. For experimental purposes, the composition of the anode material could be varied from pure Cu to pure Cu<sub>x</sub>S by regulating the duration of treatment with sulfur vapor. The experiment demonstrated passage of Cu from Cu<sub>x</sub>S into the dielectric during tunneling breakdown of the latter, by the mechanism of evaporation in an electric field. No such movement of Cu occurred in Si-SiO<sub>2</sub>-Cu structures either with Si as anode or with Cu as anode but without supply of sulfur vapor. Reversal to the high-resistance state is accompanied by return of Cu into the anode, which becomes difficult when the latter already contains metallic Cu. The reversal current and the number of switching cycles depend on the composition of the anode material. Minimum reversal current and over 10<sup>6</sup> switching cycles, at temperatures from 77 K to 673 K, are attainable with a pure Cu<sub>x</sub>S anode. Figures 2; references 10: 6 Russian, 4 Western.

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SIGNIFICANCE OF EXTERNAL AND INTERNAL CONNECTIONS IN LIMITING SPEED AND  
COMPUTATIONAL THROUGHPUT OF INTEGRATED LOGIC CIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 15, No 3, May-Jun 86  
(manuscript received 21 Feb 85) pp 217-226

[Article by K. K. Svidzinskiy]

[Abstract] An attempt is made to determine the limitations placed by the external connections of integrated circuits and their internal connections on the two most important characteristics of the circuits--speed and computational throughput. The speed of integrated circuits is found to be proportional to the speed of their logic elements only where logic element speed is comparatively low. After a certain level is reached, increasing logic element speed has a logarithmic effect on integrated circuit speed. The variation of throughput as a function of scale of integration is not monotonic, but rather has a maximum corresponding to the optimal level of integration, which can be reached at present. The most important factor in increasing throughput is the ratio of heat liberated to signal energy of external connections, which is determined by the length of the connections between circuits. New methods of bodiless construction of IC's on alundum ceramic plates can increase throughput by a factor of 60. The transition to 3-dimensional topology of intercircuit connection using optoelectronic connections in the third dimension might achieve still further increases. References 12: 9 Russian, 3 Western.

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ESTIMATING INTERFERENCE IMMUNITY OF INTEGRATED MICROCIRCUIT

Moscow ELEKTROTEKHNIKA in Russian No 5, May 86  
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[Article by A. A. Yevlikov, candidate of technical sciences and G. T. Lazutin, engineer, All-Union Institute of Electrical Engineering imeni V. I. Lenin]

[Abstract] A procedure for estimating the interference immunity of integrated-microcircuit control, regulation, and protective devices is proposed, on the basis of universal macromodel which simulates time delay, linear amplification, and nonlinearities. It is preferable to determination of the minimum volt-second area which an interference pulse must have to cause a change of logic state, this minimum area depending on the pulse duration. It is also preferable to determine the maximum permissible interference pulse amplitude, whose dependence on the pulse duration is different for different pulse forms. The macromodel, applicable to operational amplifiers and TTL devices, is analyzed on the basis of its resistive equivalent circuit. The algorithm of calculating the microcircuit response to various simple and compound rectangular anomalous input pulses, which involves stepwise integration of a system of differential equations and subsequent evaluation of exponential functions, has been programmed for a computer or a micro-calculator such as the BZ-34. The results are compared with experimental oscillograms for correlation and adjustment. From these data is then constructed the amplitude-time characteristic of interference susceptibility of a given microcircuit. The procedure is demonstrated on a series K155LA3 microcircuit, the parameters of its macromodel corresponding to its given mode of operation and performance requirements. Figures 5; references: 4 Russian, 1 Western in Russian translation.

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## HEATING OF HOLES IN BASE REGION OF BIPOLAR HETEROJUNCTION TRANSISTORS ON N-P-N STRUCTURES

Moscow MIKROELEKTRONIKA in Russian Vol 15, No 4, Jul-Aug 86  
(manuscript received 20 Aug 85) pp 291-298

[Article by V. I. Ryzhiy]

[Abstract] Bipolar heterojunction transistors on n-p-n structures are considered, these devices being characterized by a nonuniform plasma of hot electrons in the base region. The heating of holes by nonequilibrium electrons is analyzed on the basis of the energy band diagram, for structures with smooth heterojunction whose variband region lies completely or partly in the p-base region and for structures with steep emitter heterojunction but uniform base region. The effective hole temperature in the base region is calculated from the equation of heat conduction in the one-dimensional approximation, assuming a strongly but uniformly doped and therefore quasi-neutral base region. Into account are taken hole energy and hole momentum relaxation mechanisms as well as electron diffusion or diffusion-drift. The dependence of temperature on current density is established, which reveals that heating of holes limits the emitter efficiency but raises the cutoff frequency with increasing current density. Calculations for typical  $\text{Ga}_{1-x}\text{Al}_x\text{As-GaAs}$  and  $\text{GaP-Si}$  transistors indicate that heating of holes can limit the emitter efficiency and the current transfer ratio, thus also the gain of a common-emitter amplifier, especially at low lattice temperature down to  $T = 77$  K. Figures 1; references 32: 14 Russian, 18 Western.

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SPECIFIC LOSSES IN STEEL FOR ULTRASOUND FREQUENCY INDUCTOR ALTERNATORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 6, Jun 86 (manuscript received 24 Feb 86) pp 115-117

[Article by Georgiy Artemovich Nazikyan, graduate student, Vladimir Leonidovich Kolomeytsev, senior laboratory technician and Sergey Nikolayevich Vorobyev, undergraduate student, Novocherkassk Polytechnic Institute]

[Abstract] Specific losses in 1521 steel, one of the two grades most suitable in the form of 0.1 mm thick laminations for 8-45 kHz inductor alternators (2421 steel being the other grade), were measured on a toroidal specimen consisting of thin rings. Four coils were wound on the specimen: 30 turns for excitation with sinusoidal voltage and 30 turns for measurement of the alternating component of magnetic induction, 150 turns for magnetization with direct current and 15 turns for measurement of the constant component of magnetic induction. The frequency of magnetization reversal pulse cycles was varied over the 8-45 kHz range. A series choke with a saturable core was inserted in the d.c. magnetizing circuit so as to ensure magnetization within the linear range up to the maximum d.c. level, its inductance being sufficiently high to ensure a most constant power with the measuring circuit open or closed. A series resistor made of manginin wire, bifilarly wound and thus noninductive, was inserted in the a.c. excitation circuit so as to ensure a high power factor. Measurements were made with a ballistic galvanometer including a reference coil. The specific losses in the toroidal core were calculated from test data according to applicable relations, copper losses in the coils having been found not to exceed 0.5%. The core losses were found to increase with an increasing constant component of magnetic induction, especially above a threshold level of the latter and at higher frequencies of the alternating component. Figures 2; references: 3 Russian.

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